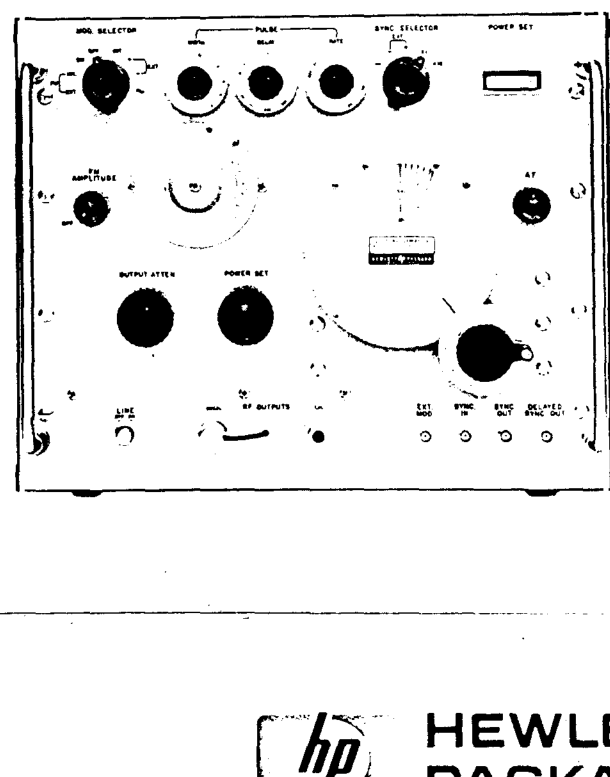
HP 618C
HP 620B

OPERATING AND SERVICE MANUAL

618C
620B
SHF SIGNAL GENERATOR



HEWLETT PACKARD

HP 618C
HP 620B

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

OPERATING AND SERVICE MANUAL

618C, 620B
SHF SIGNAL GENERATOR

SERIALS PREFIXED

618C: 1621A
620B: 1621A

This Operating and Service Manual applies directly to instruments bearing above serial prefixes.

SERIAL PREFIXES NOT LISTED

For instruments with higher serial number prefixes than above, refer to the enclosed MANUAL CHANGES supplement. For instruments with serial number prefixes lower than above, refer to Appendix II at rear of manual.

HEWLETT PACKARD

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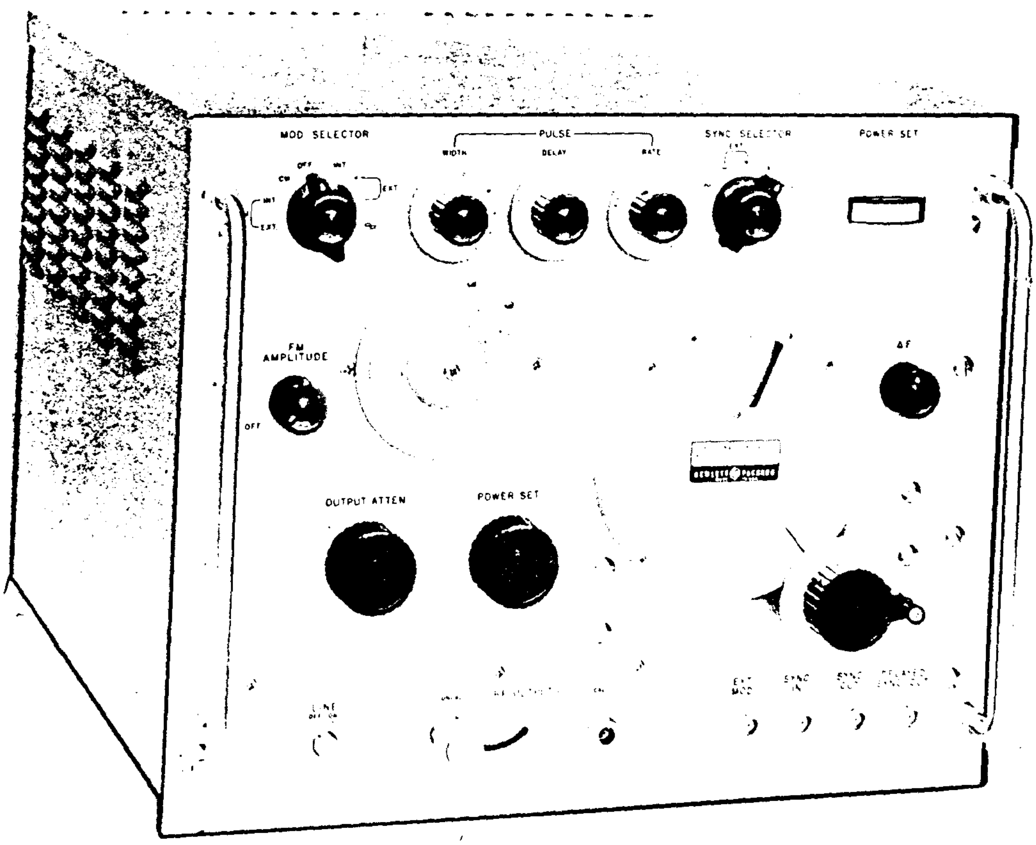


Figure 1-1. Model 618C/620B SHF Signal Generators

SECTION I
GENERAL INFORMATION

1-1. DESCRIPTION.

1-2. The Hewlett-Packard Models 618C/620B SHF Signal Generators (Figure 1-1) provide RF signal output in the frequency ranges of 3800 to 7600 MHz, and 7000 to 11,000 MHz respectively. At least 1-mW power output is available over the entire frequency range. The output frequency is indicated on a direct-reading dial. The RF output power is adjustable by an attenuator that is calibrated in μV and dB.

1-3. Five types of modulation are available: internal pulse modulation, external pulse modulation, internal frequency modulation, external frequency modulation, and internal square-wave modulation.

1-4. The internal pulse modulation has a variable repetition rate of 40 to 4,000 Hz. Pulse width is variable from 0.5 to 10 μs as measured at the pulse 50% amplitude points. Internal square wave modulation is variable from 40 to 4,000 Hz.

1-5. The Signal Generator can be modulated by external pulses of positive or negative polarity. The amplitude of the modulating pulses may be 20 to 70V, and the pulse width between 0.5 and 2500 μs.

1-6. Internal frequency modulation comprises a sawtooth sweep rate of 40 to 4,000 Hz. Frequency deviation is variable from 0 to 5 MHz over most of the band. External frequency modulation from an external sine wave is provided. Frequency deviation is approximately 5 MHz.

1-7. Synchronization outputs of the Signal Generator comprise two types: delayed, and undelayed. The delayed synchronization output is a positive pulse that occurs simultaneous with the RF pulse. The pulse has an amplitude of 25 V minimum and a rise time less than 1 μs when terminated in a load of 1000 ohms or more. The undelayed synchronization pulse has the same characteristics as the delayed pulse, except the pulse occurs between 3 to 300 μs (as adjusted by front-panel control) before the RF pulse.

1-8. Both the pulse- and frequency-modulated RF output may be synchronized with the following externally generated signals: sine waves of 40 to 4,000 Hz, and 5 to 50V amplitude; pulses of 40 to 4,000 Hz, a peak amplitude of 5 to 50V, a rise time of 0.1 to 1 μs, and a width of 0.5 to 5 μs.

1-9. INSTRUMENT IDENTIFICATION.

1-10. Hewlett-Packard instruments have a two-part serial number. The first four digits are the serial prefix. If the prefix on your instrument is not listed on the title page of this manual, in the appendix, or on a Manual Change sheet enclosed with the manual, the correct information may be obtained from any Sales and Service Office listed at the rear of this manual.

Table 1-1. Specifications

Output

Frequency Range:
618C: 3,800 to 7,600 MHz covered in a single band.
620B: 7 to 11 GHz covered in a single band.
Repeller voltage automatically tracked and proper mode automatically selected

Calibration: Direct reading. Frequency calibration accuracy better than ±1%.

Vernier: ΔF control has a minimum range of 0.5 MHz (618C), 1.5 MHz (620B) over most of the band for fine tuning. Remote ΔF connector on rear panel permits fine tuning with external potentiometer; tuning range at least 0.5 MHz (618C), 1.5 MHz (620B) over most of the band with potentiometer ≥ 2 megohms.

Frequency Stability:
With Temperature: Less than 0.006%/°C change in ambient temperature.
With Line Voltage: Less than 0.02% change for line voltage variation of ±10%.
Residual FM: < 15 kHz peak.

Output Range: 1 milliwatt or 0.224 volt to 0.1 microvolt (0 dBm to -127dBm) into 50 ohms. Directly calibrated in microvolts and dB. Coaxial Type N connector.

Output Accuracy: Within ±2 dB from -7 to -127 dBm, within ±3 dB from 0 to -7 dBm, at front panel connector, terminated in 50-ohm load. Temperature-compensated detector circuit monitors RF oscillator power level. An auxiliary, fixed-level RF output (at least 0.3 mW) is provided on the front panel for use with other equipment such as a frequency counter or phase-lock instrumentation.

Source Impedance: 50 ohms nominal; reflection coefficient less than 0.33 (2 SWR, 9.6 dB return loss.)

Modulation

Modulation: Internal or external pulse, FM, and square wave.

Internal Pulse Modulation: Repetition rate variable from 40 to 4,000 pps, pulse width variable 1/2 to 10 microseconds.

Sync Out Signals: Simultaneous with RF pulse, positive. In advance of RF pulse, positive, variable 3 to 300 microseconds. (Better than 1 microsecond rise time and 25 to 100 volts amplitude into 1,000-ohm load.)

External Synchronization:
Sine Wave: 40 to 4,000 Hz, 5 to 50 V rms.
Pulse: 40 to 4,000 pps, 5 to 50 V peak, positive or negative, 0.5 to 5μsec wide, 0.1 to 1 μsec rise time.

Internal Square Wave Modulation: Variable, 40 to 4,000 Hz, controlled by PULSE RATE control.

Internal Frequency Modulation: Sawtooth sweep rate adjustable 40 to 4,000 Hz. Frequency deviation to 5 MHz peak-to-peak over most of the frequency range.

External Pulse Modulation: Pulse requirements: amplitude from 20 to 70 volts peak positive or negative, width 0.5 to 2,500 microseconds.

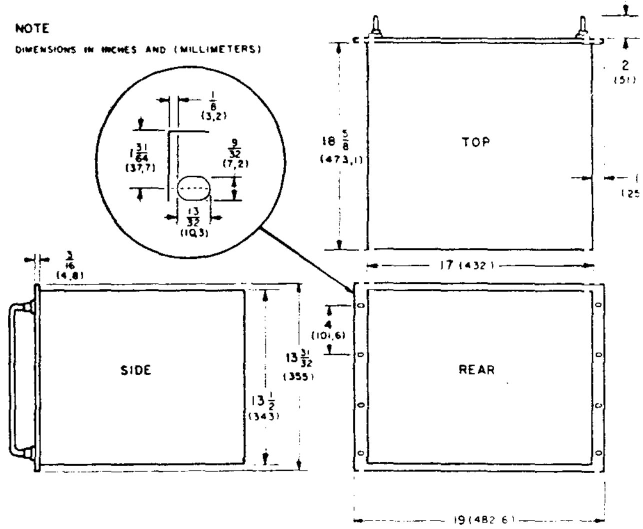
External FM: Frequency deviation approximately 5 MHz peak-to-peak over most of the band. Sensitivity approximately 20 V/MHz at front-panel connector, approximately 10 V/MHz at rear panel connector (mating connector supplied.) Front-panel connector is capacitively coupled to klystron repeller; rear-panel connector is dc coupled to klystron repeller and is suitable for phase-lock control input.

General

Power Source: 115 or 230 volts ±10%, 50 to 60 Hz, 230 W.

RFI: Conducted and radiated leakage limits are below those specified in MIL-I-6181D.

Dimensions: Cabinet Mount: 17-1/2 in. wide, 13-7/8 in. high, 20-3/8 in. deep behind panel (445 x 353 x 517 mm).
Rack Mount:



Weight: Net, 69 lbs. (31,1 kg). Shipping, 90 lbs. (40,5 kg).

Accessory Furnished: 11500A Cable Assembly, 6 feet (1830 mm) of specially treated RG-214A/U 50-ohm coaxial cable terminated at each end with UG-21D/U Type N male connectors; 7-1/2-ft. (2290 mm) power cable.

Accessories Available: 11001A Cable Assembly, 45 in. long, RG-58C/U 50-ohm Coax, terminated by dual banana connector on one end, BNC on other. 10503A Cable Assembly, 4 feet long, RG-58C/U 50-ohm Coax, terminated on each end by BNC male connectors.

SECTION II
INSTALLATION

2-1. INCOMING INSPECTION.

2-2. The Signal Generator was carefully inspected, both mechanically and electrically, prior to shipment. Inspect it for mechanical damage received in transit, check for supplied accessories, and test electrical performance using the procedure given in Section V. If there is damage or deficiency, or if electrical performance is not within specifications, see the warranty inside the front cover of this manual.

2-3. PREPARATION FOR USE.

2-4. POWER REQUIREMENTS.

2-5. The Signal Generator requires a power source of 115 or 230 V ac ±10%, single phase. The power source must supply approximately 250 W.

2-6. 115/230 VOLT OPERATION.

2-7. A two-position slide switch, on the rear panel, permits operation from either a 115 or 230 V power source. The number visible on the switch slider indicates the line voltage for which the Signal Generator is connected.

2-8. To prepare the Signal Generator for operation, set the 115-230 V switch so that the number visible on the slider corresponds to the available line voltage. Install a fuse of correct rating.

CAUTION

To avoid damage to the Signal Generator, before connecting the power cable, set the 115-230 V switch for the line voltage to be used.

2-9. POWER CABLE.

2-10. To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that the Signal Generator panel and cabinet be grounded. Accordingly, the Signal Generator is equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds the panel and cabinet. The offset pin of the three-prong connector is the ground pin.

2-11. To preserve the protection feature when operating the Signal Generator from a two-contact outlet, use a three-prong to two-prong adapter (HP Part No. 1251-0048) and connect the green pigtail on the adapter to ground.

2-12. COOLING.

2-13. Forced air cooling is used to maintain safe operating temperatures within the Signal Generator cabinet. The air intake and exhaust ports, cooling fan, and air filter are located at the rear of the cabinet. To ensure adequate ventilation, maintain about three inches of clearance behind the cabinet.

CAUTION

Do not operate the Signal Generator if the fan is not operational.

2-14. AIR FILTER.

2-15. The air filter, as received with a new Signal Generator, has a coating of dust-catching substance which improves air cleaning action. To maintain adequate ventilation, clean and recoat the air filter at regular intervals. See Section V for cleaning instructions.

2-16. REPACKING FOR SHIPMENT.

2-17. If the Signal Generator is to be packaged for shipment use the original shipping container and packing materials. If these have been discarded or not in condition for reuse, obtain new materials from your local Hewlett-Packard Sales and Service Office (see rear of this manual for locations), or follow these general instructions:

a. Wrap the Signal Generator in heavy paper or plastic. (If the Signal Generator is being shipped to a Hewlett-Packard service facility, attach a tag indicating type of servicing required, return address, model number, and full serial number.)

b. Use a strong shipping container. A carton made of 500- to 600-pound test material will usually provide adequate protection.

c. Use enough shock-absorbing material (3- to 4-inch layer) around all sides of instrument to provide firm cushion and prevent movement inside the container. Protect the control panel with cardboard. With Hewlett-Packard "floater pack" packaging, the foam blocks provide sufficient shock protection, and additional material is unnecessary.

d. Seal the shipping container securely.

e. Mark the shipping container "FRAGILE" to assure careful handling.

2-18. In any correspondence refer to the Signal Generator by model number and full serial number.

SECTION III
OPERATION

3-1. INTRODUCTION.

3-2. This section provides instruction to properly operate the Signal Generator. Included are general operating information; a description of controls, connectors, and indicators; and basic operating procedures for each mode of operation.

3-3. GENERAL OPERATING INFORMATION.

CAUTION

Do not connect RF or dc power in any magnitude to the output terminals of this instrument. As little as 0.2 W can permanently damage the attenuator probe. Extreme care should be exercised when working with transceiver-type equipment to insure that the transmitter section is not operating while the Model 618C/620B is connected to the transceiver antenna.

3-4. OUTPUT ACCURACY. The accuracy of the output system and the calibration of the attenuator in the Model 618C/620B is determined at the front-panel output jack. Output cable losses must be considered in addition to the attenuator dial indication when employing specific signal levels at the end of the output cable.

3-5. Erratic instrument performance at the output terminals, or no power output is frequently an indication that the instrument has been subjected to abuse. This condition may be confirmed by measuring either the dc resistance of the attenuator or the SWR looking into the panel connector. Dc resistance is approximately 50 ohms. SWR (at panel connector) is 2.0 or less.

3-6. The klystron used in this instrument is expensive and has a shorter life (approximately 1000 hours) than that of a conventional vacuum tube. Power should be removed from the Signal Generator when it is not in use in order to increase the useful life of the klystron.

3-7. CONTROLS, CONNECTORS AND INDICATORS.

3-8. Front-panel controls, connectors, and indicators are shown and described in Figure 3-1.

3-9. BASIC OPERATING PROCEDURES.

3-10. TURN ON.

a. Set rear-panel 115-230V switch to match line voltage, and check that the line fuse has correct rating.

b. Connect Signal Generator to power source.

c. Depress LINE switch. Allow 5-minute warm-up time. If ambient temperature is below 10°C (50°F), allow a longer warmup period.

3-11. DETAILED OPERATING PROCEDURES.

CAUTION

Do not use the Signal Generator if the cooling fan does not operate at turn-on.

3-12. Detailed operating procedures are given in Figure 3-2 through 3-7.

3-13. OPERATION WITH THE DYMEC DY-2650A OSCILLATOR SYNCHRONIZER.

The 618C/620B is easily adapted for use with the DY-2650A Synchronizer as follows:

1. Remove the internal shorting jumper from J303, pins A & B. Refer to Figure 5-22. The jumper is connected between the klystron reflector and its power supply across R526.
2. Connect the mating connector J7 to P2 on the DY-2650A. This is to protect a user from accidentally contacting the otherwise exposed pins of P2, one of which will be at the reflector potential after completion of step 3.
3. Connect the klystron reflector lead and the reflector voltage lead to pins G and F, respectively, of J5 on the DY-2650A. An RG-59A/U type cable is recommended for this connection.

No other modifications are normally required. The RF sample for the DY-2650A must be obtained from the signal generator output connector through a suitable coupler. Varying the output level from the signal generator to the device being tested will also vary the RF sample level into the DY-2650A. It is therefore necessary to set the RF output level from the signal generator to a fixed value and to use an external attenuator for varying the level to the device under test if wide ranges in level are required.

CAUTION

When the shorting jumper has been removed from the klystron reflector supply voltage as described in step 1 above, the 620B must not be operated without being connected to the DY-2650A unless the reflector lead jumper is replaced. Omission of the jumper will damage the klystron.

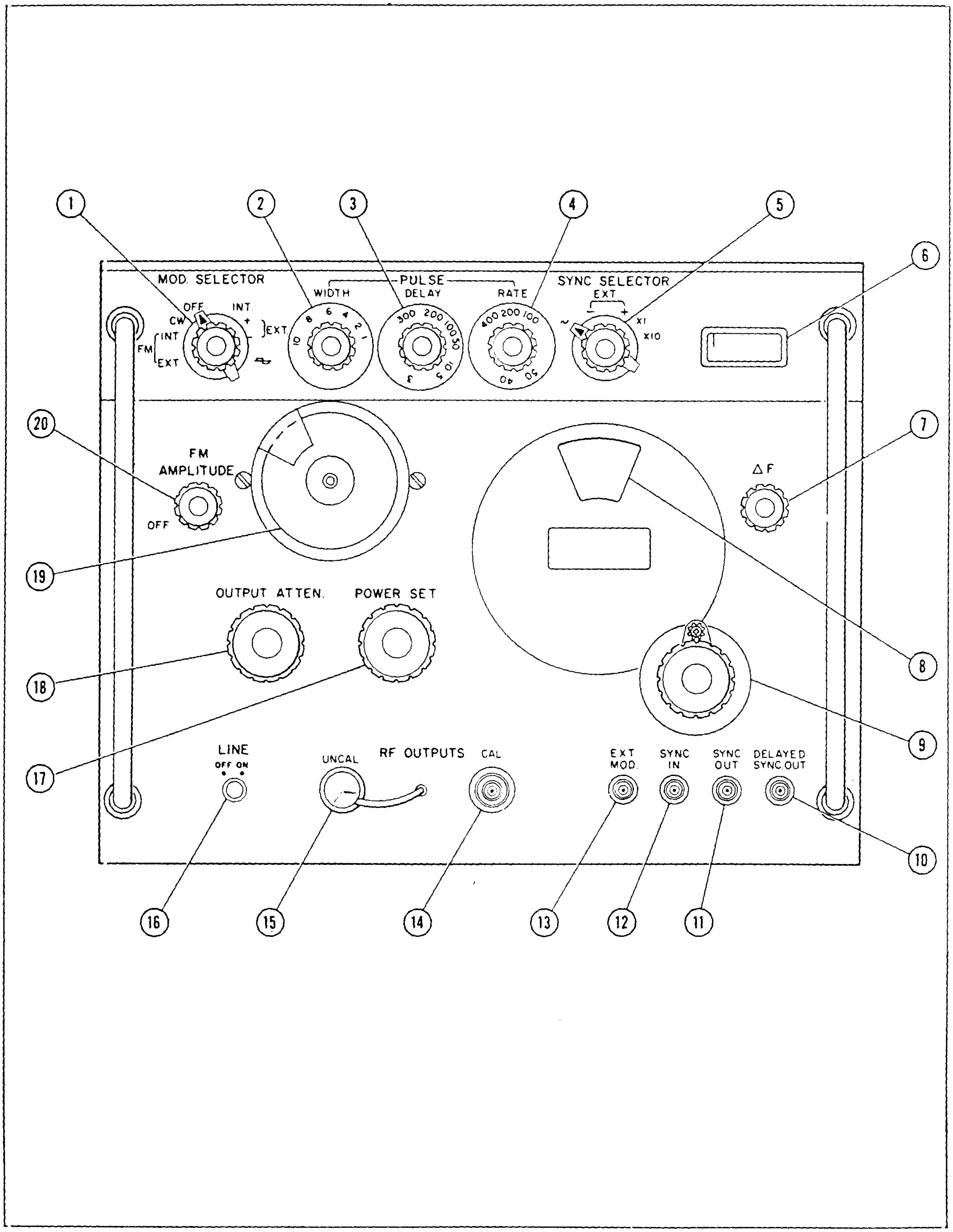
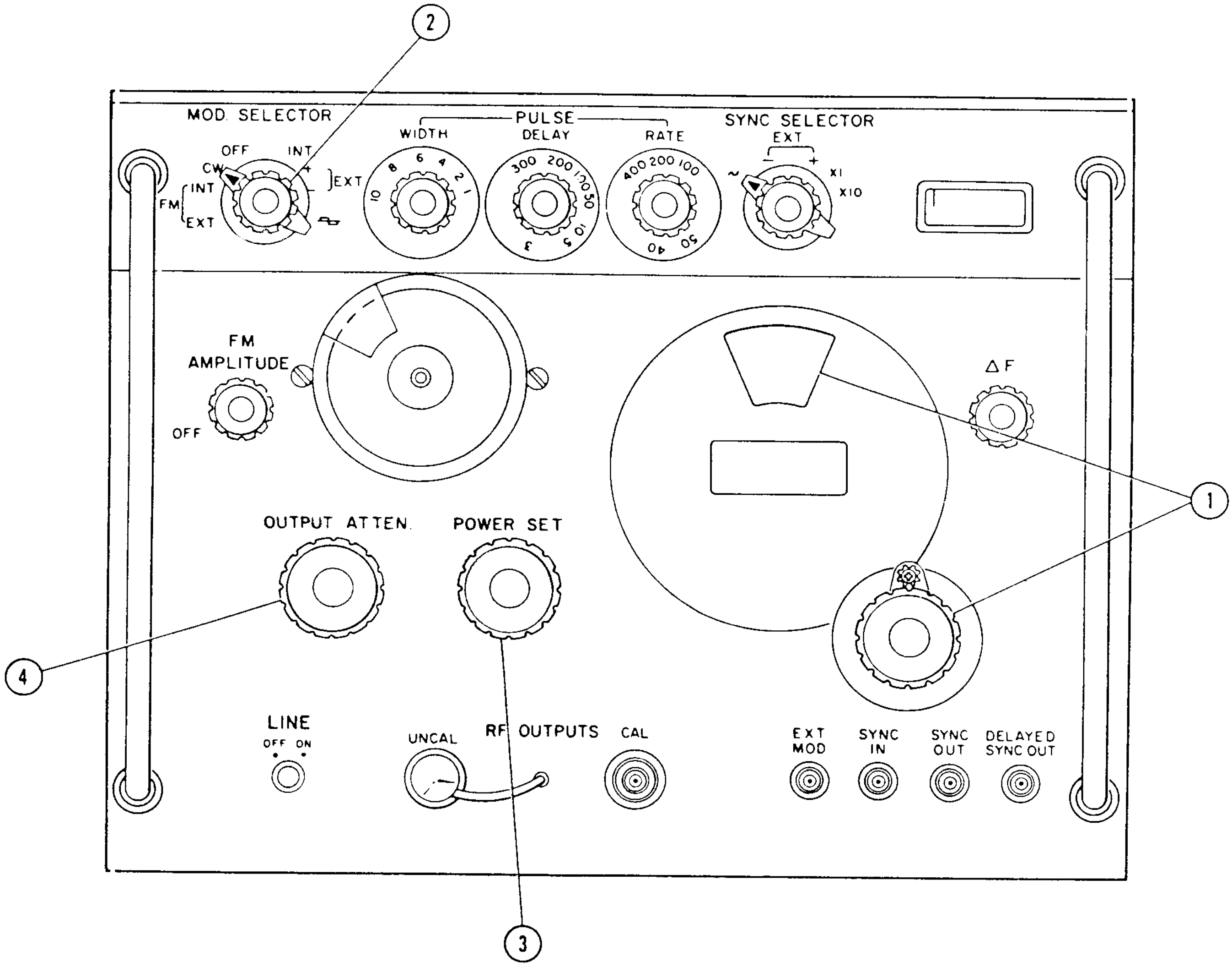


Figure 3-1. Front-panel Controls, Connectors, and Indicators (Part 1 of 2)

1. MOD. SELECTOR. In FM EXT position, sine wave or sawtooth applied to EXT. MOD connector modulates Signal Generator. In FM INT position, an internally generated sawtooth modulates the Signal Generator. In CW position, the Signal Generator is not modulated. In OFF position, Signal Generator RF output is disabled. In INT. position, the Signal Generator is modulated by internally generated pulses. In EXT+ position, the Signal Generator can be modulated by positive pulses applied to the EXT. MOD. connector. In EXT- position, the Signal Generator can be modulated by negative pulses applied to the EXT. MOD. connector. In ⊓⊔ position Signal Generator is modulated by internally generated square waves (approximately 50% duty cycle).
2. PULSE WIDTH. Adjusts width of modulating pulse when MOD. SELECTOR is set to INT.
3. PULSE DELAY. Adjusts the delay time between synchronizing pulse and RF output pulse from 3 to 300 μs.
4. PULSE RATE. Adjusts pulse repetition rate of modulation when MOD SELECTOR is set to INT. FM INT, or ⊓⊔ position and SYNC SELECTOR is in X1 or X10 position. When SYNC SELECTOR is in X1 position, pulse rate is indicated by PULSE RATE control; when SYNC SELECTOR is in X10 position, pulse rate is 10 times that indicated by PULSE RATE control.
5. SYNC SELECTOR. In ~ position, and when MOD. SELECTOR is set to INT, Signal Generator may be synchronized by external sine-wave signal of 5-50 V rms applied to SYNC. IN connector. In EXT- position, and when MOD. SELECTOR is in INT position, Signal Generator must be synchronized by negative pulses (5-50 V peak-to-peak) applied to SYNC. IN connector. In EXT+ position, and when MOD. SELECTOR is set to INT, the Signal Generator must be synchronized by external positive pulses (5-50 V peak-to-peak) applied to the SYNC. IN connector. In X1 position, and MOD. SELECTOR is set to INT, the modulation repetition rate is as indicated by the PULSE RATE control. In the X10 position, and when MOD. SELECTOR is set for INT, the modulation repetition rate is 10 times that indicated by the PULSE RATE control.
6. Power Meter. Indicates RF power input in dBm to attenuator.
7. ΔF. Provides up to 0.5 MHz adjustment of output frequency for 618C; 1.5 MHz for 620B.
8. MHz/GHz. Indicates RF output frequency in megahertz/gigahertz for 618C/620B respectively.
9. Frequency Control. Adjusts RF output frequency.
10. DELAYED SYNC. OUT. Delayed (3-300 μs) synchronization signal is available at this connector.
11. SYNC. OUT. Undelayed synchronization output signal is available at this connector.
12. SYNC. IN. External synchronization signal is applied to this connector.
13. EXT. MOD. External modulation signal is applied to his connector.
14. RF OUTPUTS CAL. Source of calibrated RF power is available at this connector.
15. RF OUTPUTS UNCAL. Uncalibrated RF output power is available at this connector.
16. LINE. Turns Signal Generator on and off.
17. POWER SET. Adjusts RF power input to attenuator.
18. OUTPUT ATTEN. Adjusts RF output power to a calibrated level.
19. Attenuator Dial. Indicates RF output level when power meter is indicating 0.
20. FM AMPLITUDE. Adjusts frequency deviation of RF when using frequency modulation.

Figure 3-1. Front-Panel Controls, Connectors, and Indicators (Part 2 of 2)



Note

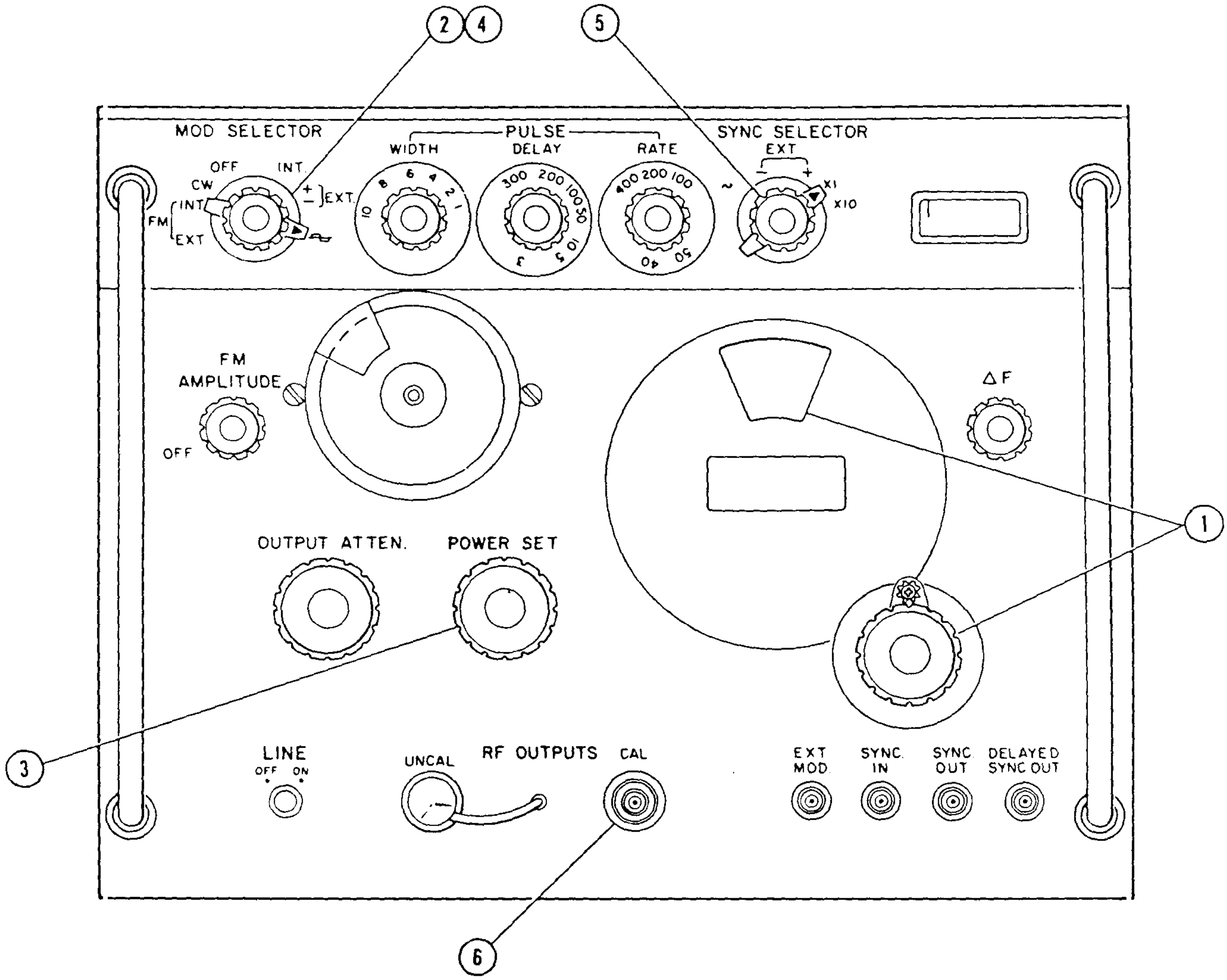
Perform turn-on procedure described in paragraph 3-10.

1. Adjust frequency control for desired RF output frequency as indicated on dial. ΔF is vernier turning which can be adjusted by the knob on the front panel or by varying a potentiometer connected to the ΔF connector on the rear (see specifications).
2. Set MOD. SELECTOR to CW.
3. Adjust POWER SET for 0 indication on power meter.
4. Adjust OUTPUT ATTEN. for desired output level as indicated by attenuator dial.

Note

ΔF control should be centered when not in use.

Figure 3-2. CW Operation



Note

Perform turn-on procedure described in paragraph 3-10.

1. Adjust frequency control for desired RF output frequency as indicated on dial.
2. Set MOD. SELECTOR to CW.
3. Adjust POWER SET for 0 indication on power meter.
4. Set MOD. SELECTOR TO ⎍.
5. Set SYNC SELECTOR TO X1 or X10 and adjust PULSE RATE control for desired square-wave frequency.
6. Connect RF cable between RF OUTPUTS CAL. connector and equipment being tested.

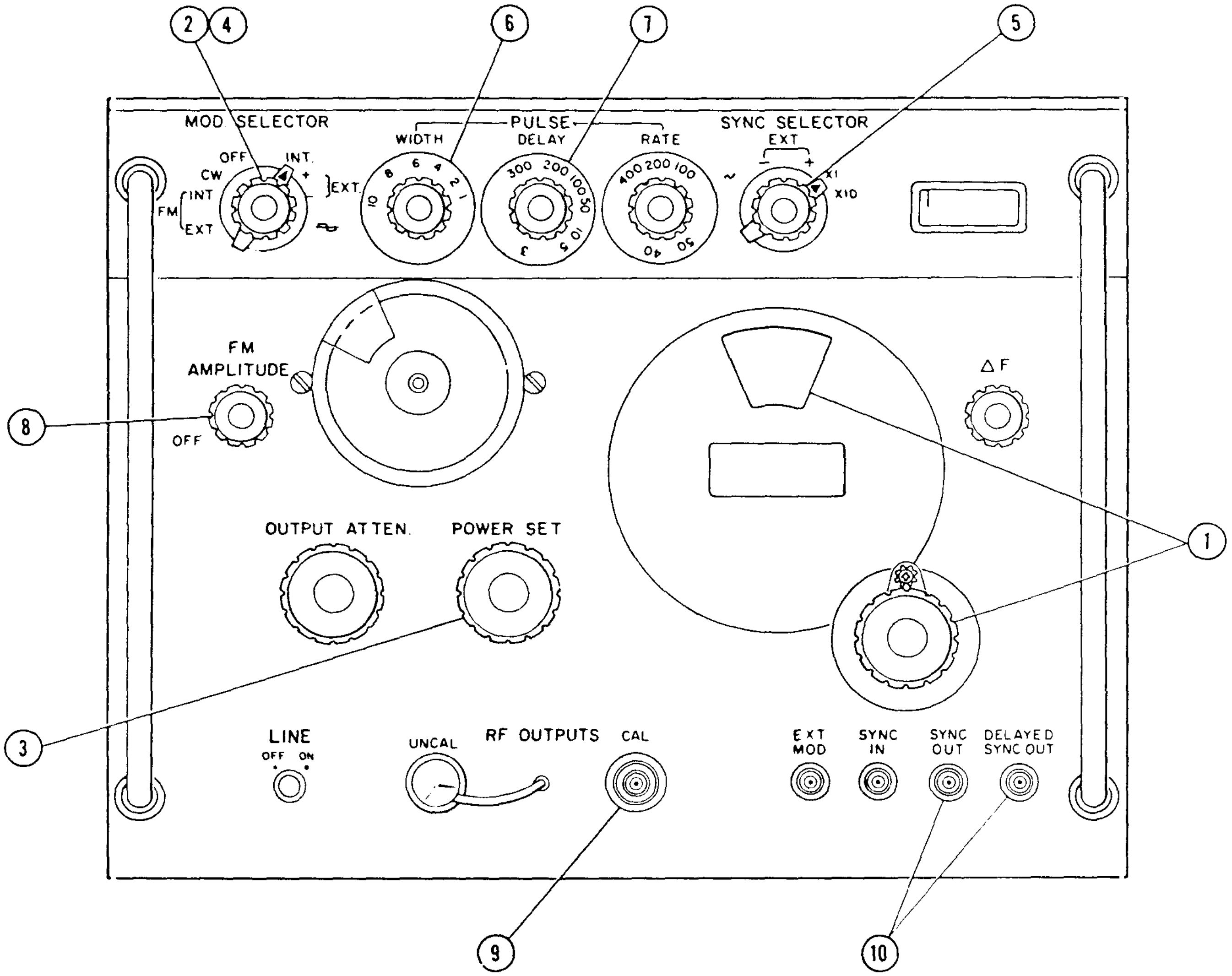
Note

Synchronization pulses occurring at the modulation rate are available at the SYNC. OUT connector.

Note

ΔF control should be centered when not in use.

Figure 3-3. Internal Square-Wave Modulation Operation



Note

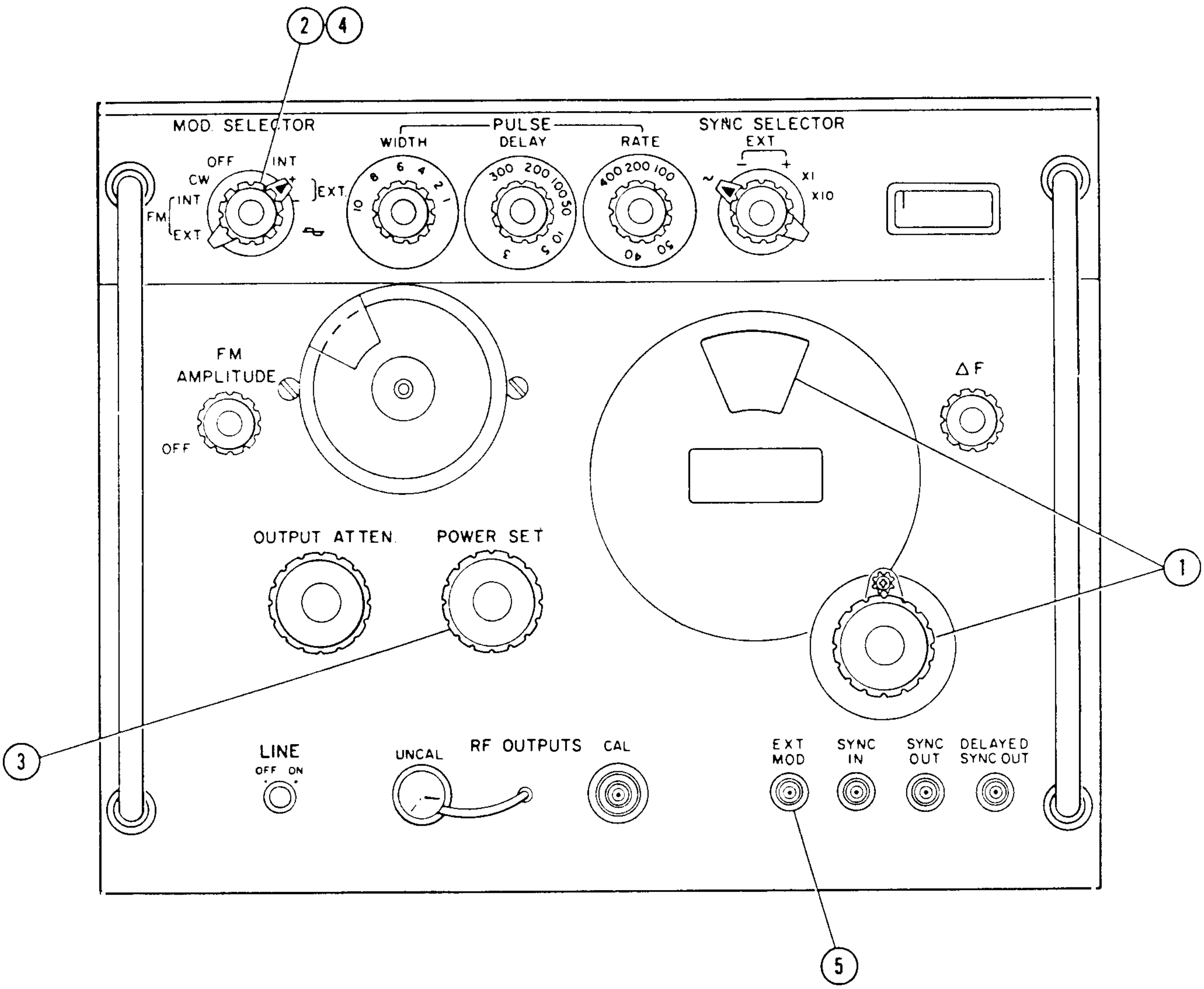
Perform turn-on procedure described in paragraph 3-10.

1. Adjust frequency control for desired RF output frequency as indicated on dial.
2. Set MOD. SELECTOR to CW.
3. Adjust POWER SET for 0 indication on power meter.
4. Set MOD. SELECTOR to INT.
5. Set SYNC SELECTOR to X1 or X10, and adjust PULSE RATE control for desired pulse repetition rate.
6. Adjust PULSE WIDTH control for desired modulation pulse width.
7. Adjust PULSE DELAY control for desired delay time.
8. Set FM AMPLITUDE control to OFF.
9. Connect RF cable between RF OUTPUTS CAL connector and equipment being tested.
10. Connect pulse cable between the SYNC OUT and or DELAYED SYNC OUT connectors and external equipment as required by the application.

Note

ΔF control should be centered to obtain optimum pulse rise and decay.

Figure 3-4. Internal Pulse Modulation Operation



Note

Perform turn-on procedure described in paragraph 3-10.

1. Adjust frequency control for desired RF output frequency as indicated on dial.

2. Set MOD. SELECTOR to CW.

3. Adjust POWER SET for 0 indication on power meter.

4. Set MOD. SELECTOR to EXT or EXT-, as required by the polarity of the external modulating pulses.

5. Connect external modulating source to EXT. MOD. connector. External modulating pulses must have peak-to-peak amplitude of between 20 and 70V.

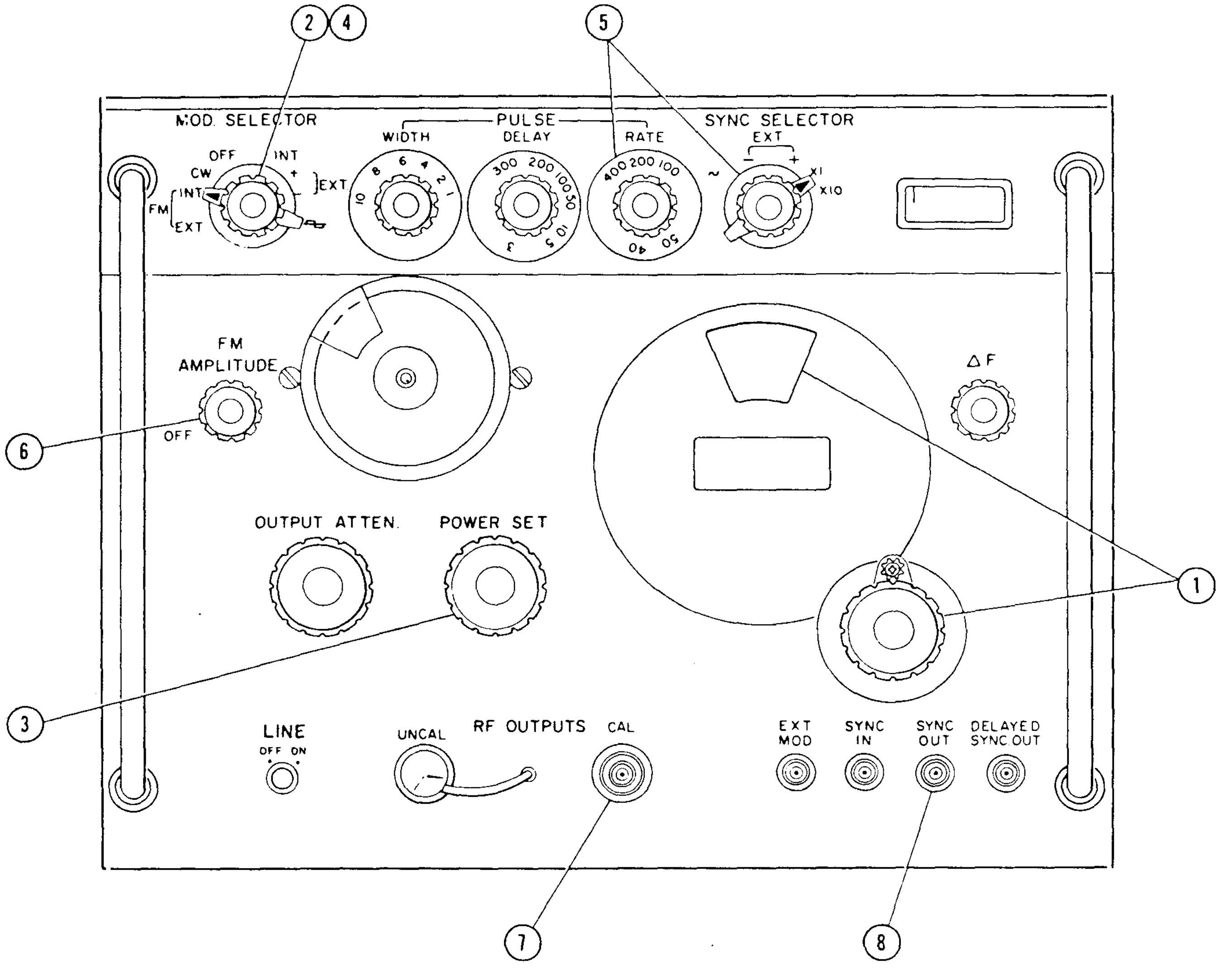
Note

In this mode of operation, no synchronization pulses are available at the DELAYED SYNC. OUT or SYNC. OUT connector.

Note

ΔF control should be centered to obtain optimum pulse rise and decay.

Figure 3-5. External Pulse Modulation Operation



Note

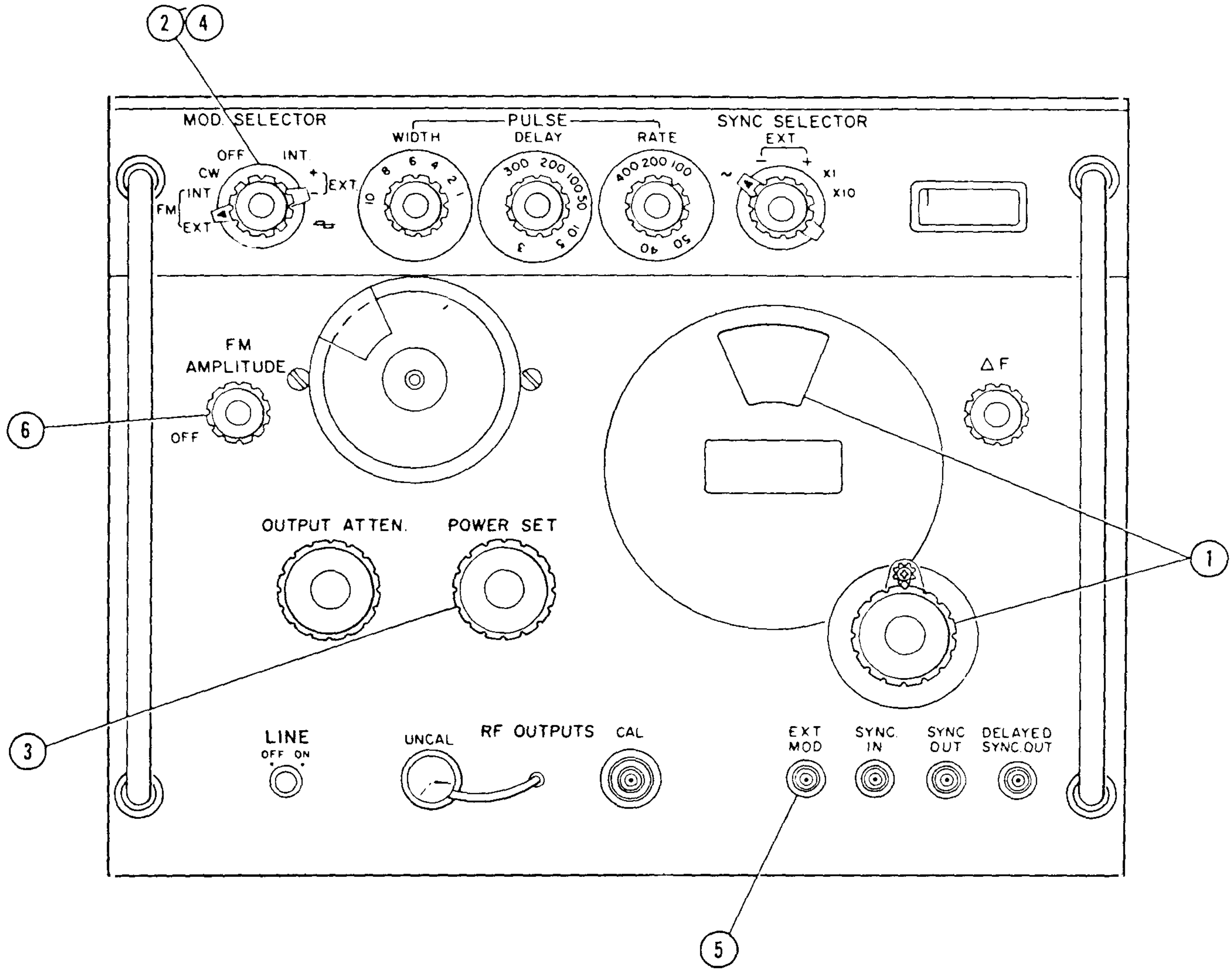
Perform turn-on procedure described in paragraph 3-10.

1. Adjust frequency control for desired RF output frequency as indicated on dial.
2. Set MOD. SELECTOR to CW.
3. Adjust POWER SET for 0 indication on power meter.
4. Set MOD. SELECTOR to FM INT.
5. Set SYNC SELECTOR to X1 or X10 and adjust PULSE RATE control for desired modulation frequency.
6. Set FM AMPLITUDE to OFF, and then carefully turn the control clockwise until the desired degree of frequency deviation is obtained. Because of klystron characteristics, unstable operation will occur when the control has been advanced to the point where the FM deviation is greater than the stable portion of the mode.
7. Connect RF cable between RF OUTPUTS CAL connector and equipment under test.
8. If desired, connect pulse cable between SYNC. OUT. CONNECTOR and external equipment.

Note

ΔF control should be centered to allow the klystron to operate in the center of the mode.

Figure 3-6. Internal Frequency Modulation Operation



Note

Perform turn-on procedure described in paragraph 3-10.

1. Adjust frequency control for desired RF output frequency as indicated on dial.
2. Set MOD. SELECTOR to CW.
3. Adjust POWER SET for 0 indication on power meter.
4. Set MOD SELECTOR to FM EXT.
5. Connect external modulation voltage to the EXT. MOD. connector. The modulation signal should have a level of at least 70 V rms.
6. Set FM AMPLITUDE to OFF, and then carefully turn the control clockwise until the desired degree of frequency deviation is obtained. Because of klystron characteristics, unstable operation will occur when the control has been advanced to the point where the FM deviation is greater than the stable portion of the mode.

Note

In this mode of operation, no synchronization pulses are available at the DELAYED SYNC. OUT or SYNC. OUT connector.

Note

ΔF control should be centered to allow the klystron to operate in the center of the mode.

Figure 3-7. External Frequency Modulation Operation

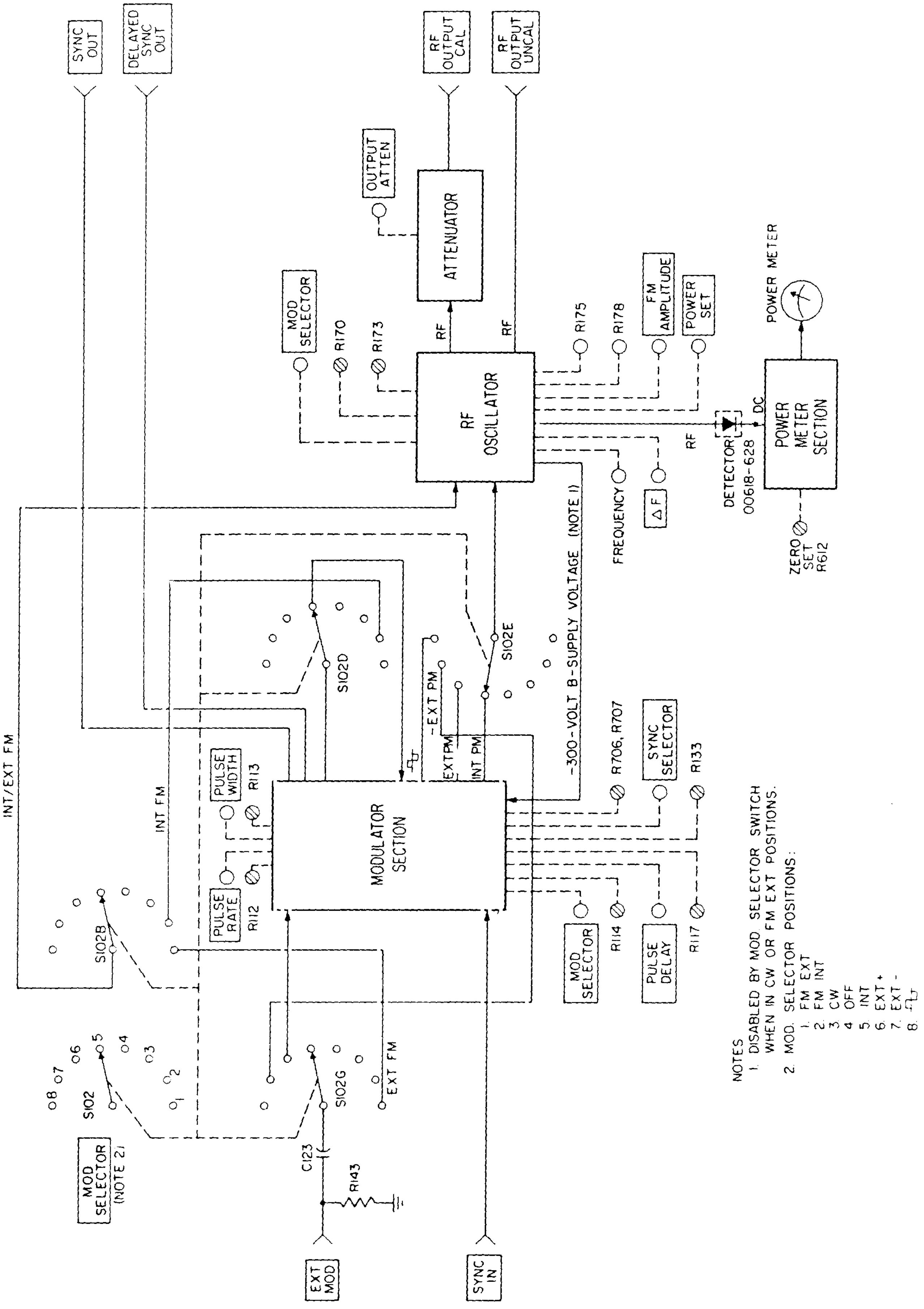


Figure 4-1. Simplified Block Diagram

SECTION IV
PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. This section contains explanations of the operation of the Signal Generator circuits. Figure 4-1 is a simplified block diagram showing principal circuit sections and operating controls. Each circuit section and important individual circuits are explained in succeeding paragraphs.

4-3. THE MODULATOR SECTION.

4-4. The Modulator Section is shown in block diagram form in Figure 4-2. The function of the circuits in this section is to establish a modulating pulse (for pulse operation) or a sawtooth voltage (for frequency modulation) and to apply it to the RF oscillator to obtain the desired type of RF output. Various portions of these circuits are not employed in certain types of operation, such as external pulse or external FM operation (see Figure 4-1). However, the block diagram shows the condition (delayed pulse output with external synchronization) where all of the circuits are employed, and the description will cover this type of operation. Other types of operation will be described in later paragraphs.

4-5. SYNCHRONIZING CIRCUITS. These circuits accept the external synchronizing voltage applied at the SYNC IN connector, and transform it into a negative pulse to trigger Pulse Rate Multivibrator V103. The circuit elements are shown in Figure 4-3. The grid of V101A is returned to B+ (ground). This places the grid at zero bias and the tube is conducting through plate load resistor R103. The tube responds to both positive and negative signals.

4-6. The negative-going portion of a sine-wave synchronizing voltage, or a negative synchronization pulse, causes the tube to cut off, developing a positive pulse in its plate circuit. This pulse is applied to the grid of V101B. Tube V101B is cut off (bias of -15 V) and the positive pulse from the plate of V101A causes V101B to conduct; thus, its plate voltage drops and the output is a negative-going pulse with a steep leading edge.

4-7. This negative pulse is applied to the ~ and (-) contacts of SYNC SELECTOR switch S101A through Series Clipper V102A. Clipper V102A develops only negative pulses at its output.

4-8. When a positive external synchronization pulse is applied to the grid of V101A, a negative pulse is developed in its plate circuit and applied through capacitor C103 to the + contact of S101A.

4-9. PULSE RATE MULTIVIBRATOR, SYNC CONDITION. When external sine-wave synchronization signals are employed, the Synchronization Multivibrator is switched to the operating condition shown in Figure 4-4. This circuit is a one-shot multivibrator, with V103A drawing current while V103B is cut off. The negative pulse from the synchronization input circuits causes the multivibrator to switch at t_1, developing a negative pulse in the plate circuit of V103B. The width of the pulse is determined by the length of time required to discharge capacitor C111 through resistor R115.

4-10. PULSE RATE MULTIVIBRATOR, FREE-RUNNING CONDITION. In the FM INT, INT (pulse), and ⊓⊔ positions of MOD. SELECTOR switch S102, the Pulse Rate Multivibrator is converted to a free-running multivibrator (Figure 4-5). Under this condition the synchronization input circuits are disconnected from the multivibrator.

4-11. The time constants of the multivibrator are balanced so that the circuit generates a wave that is essentially square with approximately a 50% duty cycle; however, this may vary depending upon the repetition rate. This arrangement is used so that internal square-wave as well as internal pulse modulation of the RF Oscillator can be obtained. The arrangement also provides for equally spaced pulses to trigger the Sawtooth Generator when internal FM modulation is being used.

4-12. PULSE SHAPER. The Pulse Shaper (Figure 4-6) is a One-Shot Multivibrator with a 2-μs pulse duration. It consists of V104A and V104B, two halves of type 5814A dual triode. In the steady-state condition, V104A is conducting as its grid is returned to the cathode by resistor R121. Tube V104B is cut off as its grid is returned to -300V, thus placing a bias on the grid (developed by the current through V104A and cathode resistor R120).

4-13. When this multivibrator is triggered by the negative-going leading edge of the waveform generated by the Pulse Multivibrator, a positive 2-μs pulse appears at the plate of V104A.

4-14. The positive output pulse is applied to the Synchronization Amplifier tube, V105A, shown in Figure 4-7, and to Synchronization Cathode Follower V105B, shown in Figure 4-6.

4-15. SYNCHRONIZATION CATHODE FOLLOWER. This stage provides the undelayed synchronization output signal for synchronizing external equipment. It is comprised of V105B, one half of a type 5814 dual-triode tube. The output is taken across R129, the cathode resistor, and is capacitively coupled through C118 to the SYNC. OUT connector. Resistor R130 is returned from the center conductor of the connector to ground, so that the line is terminated in reference to ground instead of the -300V potential existing at the base of the cathode resistor.

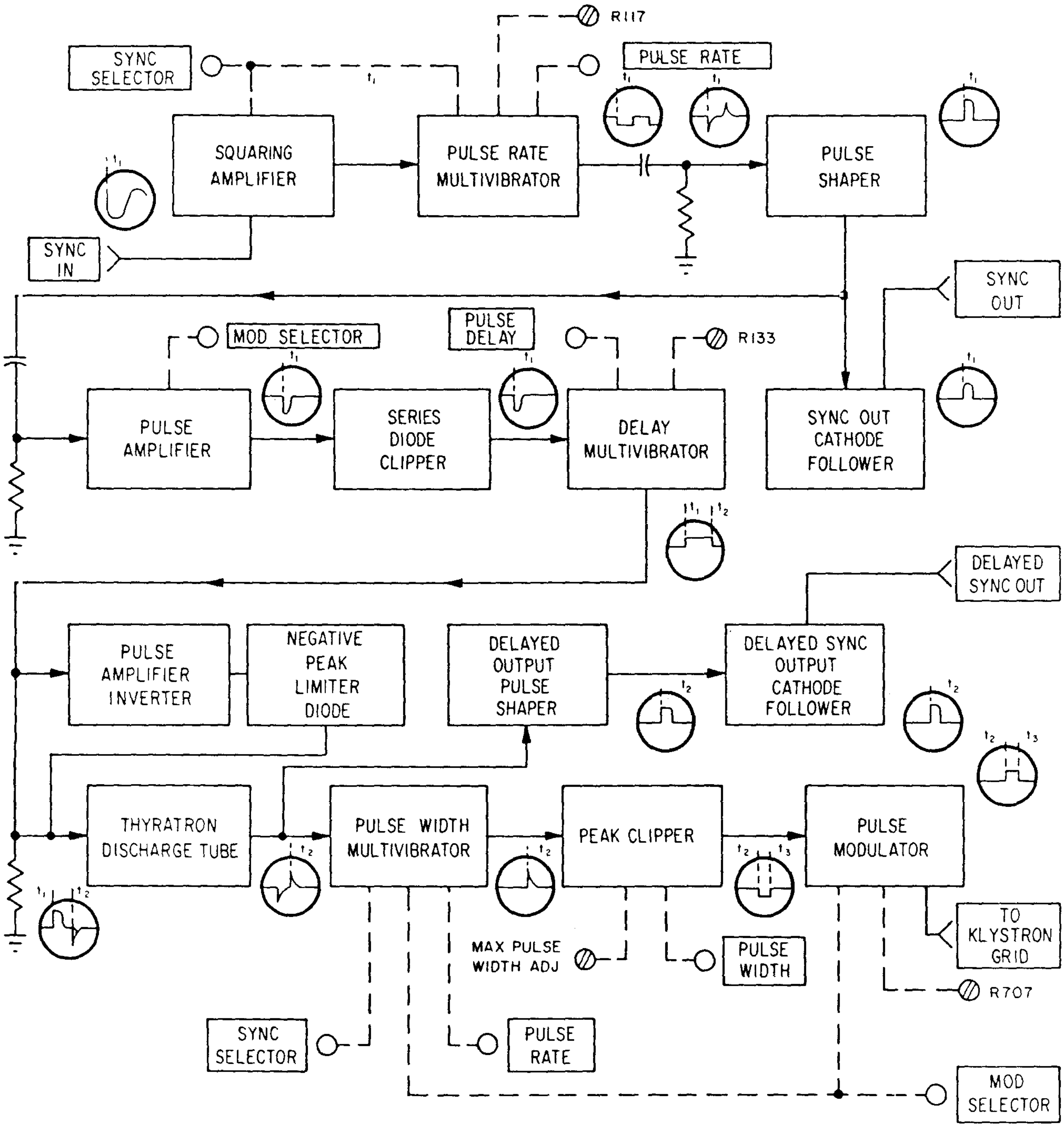


Figure 4-2. Modulator Section Block Diagram

4-16. The output of the Cathode Follower is a positive pulse greater than 25 V peak-to-peak when applied to a load having a resistance of from 1000 to 100,000 ohms and a shunt capacitance of 500 pF.

4-17. PULSE AMPLIFIER. The Pulse Amplifier is comprised of V105A, one-half of a type 12AU7 tube (Figure 4-7), and its associated components. It amplifies and inverts the 2 μs pulse provided by the Pulse Shaper and provides a positive pulse (in its cathode circuit) that is employed to trigger the Sawtooth Generator when internal frequency modulation is employed. Capacitor C115 acts as a cathode bypass capacitor when internal pulse modulation is used.

4-18. SERIES LIMITER. The negative pulse from the plate of the Pulse Amplifier is applied to the cathode of diode limiter V106A (Figure 4-7). This limiter is so connected that only the negative components with an amplitude greater than the diode bias are applied to the cathode of the Delay Multivibrator. This prevents triggering the multivibrator by any positive or low-amplitude negative transients that may appear on the output of V105A in addition to the desired trigger pulse.

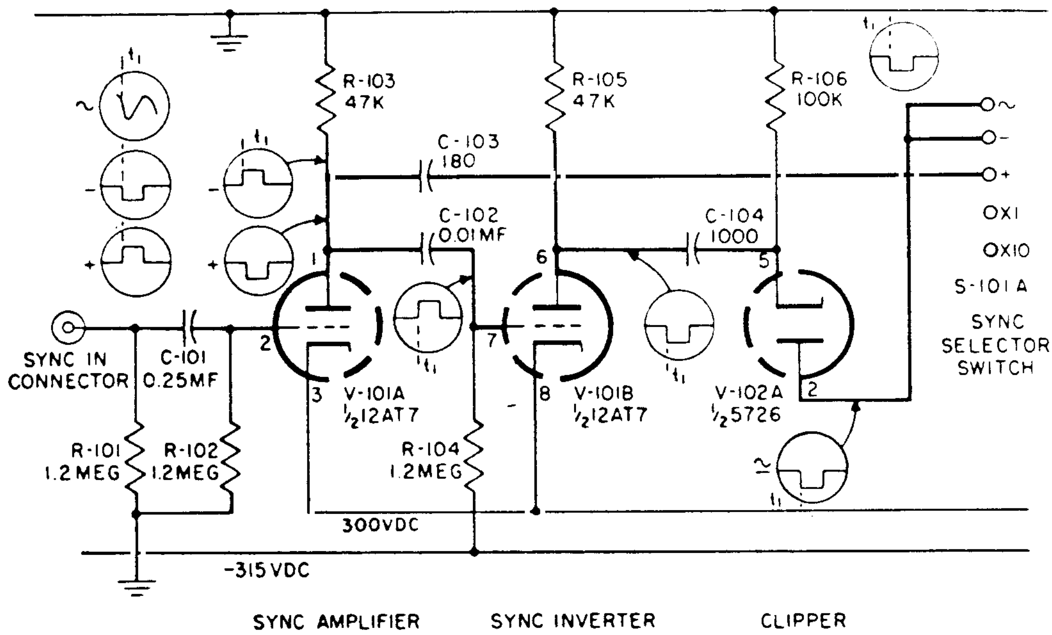


Figure 4-3. Schematic Diagram of Synchronizing Circuits

4-19. DELAY MULTIVIBRATOR. This circuit (Figure 4-7) provides an adjustable time delay in applying the modulation to the RF Oscillator. It consists of a type 12AU7 dual triode, V107, connected as a one-shot multivibrator with an adjustable resistor R136, the PULSE DELAY control.

4-20. The Delay Multivibrator starts its cycle when a negative pulse drives the cathode of V107A in a negative direction. This is equivalent to placing a positive signal on the grid, and the tube conducts. A negative wave-front appears at the plate of V107A and (through capacitor C120) drives the grid of V107B in a negative direction, cutting off this half of the stage. The length of time the circuit requires to return to its resting condition is determined by the time constant of C120, R136 and R137. Potentiometer R136 is the PULSE DELAY control that adjusts the delay from 3 to 300 μs while Potentiometer R133 is an adjustment used to set the maximum delay to 300 μs.

4-21. In the steady-state condition V107A is cut off while V107B is conducting through plate load resistors R138, R139 and R140, in parallel with resistor R142 and diode V106B.

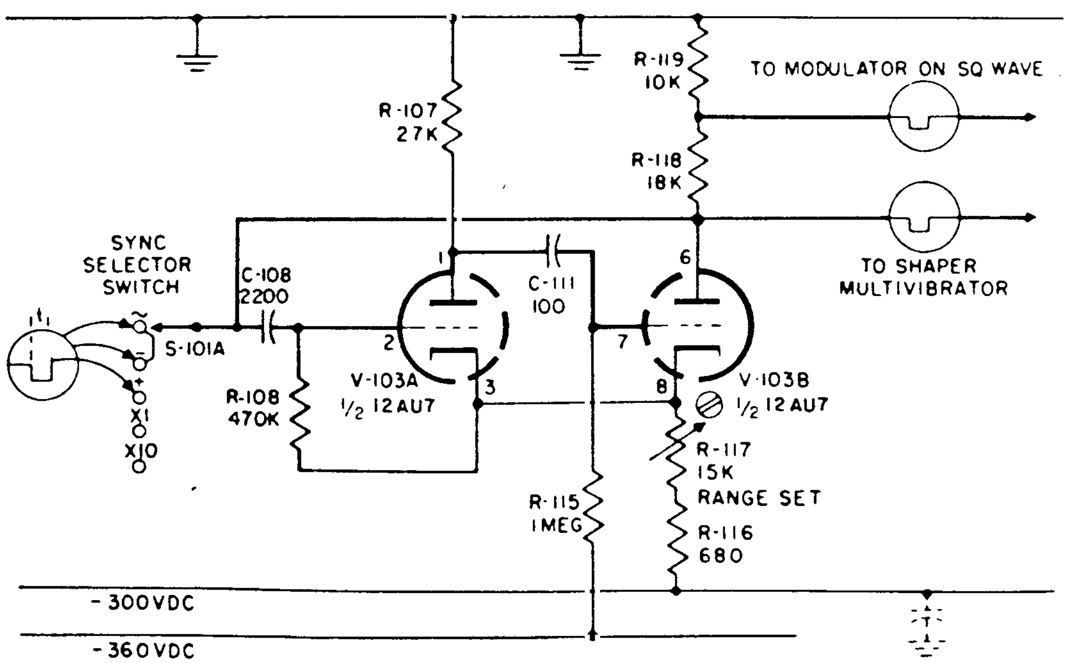


Figure 4-4. Schematic of Pulse-Rate Multivibrator, Synchronized Condition

is connected to the positive supply point (ground) through resistor R162. As a result, the other side of capacitor C130 is at a relatively higher potential due to the drop across resistor R158.

4-33. When the positive pulse at t_2 is applied to the grid of V111A, V111A immediately conducts, causing the V111A side of capacitor C130 to rise to the potential established by the current through resistor R156; thus, resistor R156 acts as a maximum delay-time adjustment for the circuit.

4-34. The voltage rise across resistor R156 is applied to the cathode of V111B, causing it to become more positive with respect to its control grid. This cuts off the tube rapidly, since the grid is maintained at the cathode potential by the time constant of R162 and C132.

4-35. Capacitor C130 is now charged and commences to discharge. The time required to discharge to a point where V111B again conducts determines the duration of the negative output pulse. The width is adjusted by R158, the PULSE WIDTH control. This control can be adjusted to provide pulses between 0.5 and 10 μs. The output of the Pulse Length Multivibrator is a negative pulse, starting at t_2 and ending at t_3. Diodes CR101, CR102 serve to limit the negative pulse to approximately 10 V peak-to-peak. The limited pulse is applied to Klystron Modulator tube V701.

4-36. KLYSTRON MODULATOR (618C). The Klystron Modulator (Figure 4-11) is comprised of tube V701 and associated parts. The modulation pulse is applied through capacitor C701 to the grid of V701. The output of the Klystron Modulator is developed across plate resistors R703 and R705. Diode CR703 serves as a clipper to limit the amplitude of the pulse applied to the Klystron. When the pulse at the plate of V701 is more positive than the voltage present at the cathode of CR703, the diode conducts and limits the pulse. The voltage at which CR703 conducts is established by the setting of potentiometer R706, part of a voltage divider (R702, R706, R708) connected between the -300 and -1000 volt lines. When the Signal Generator frequency control is at a predetermined setting, switch S103 is actuated and places potentiometer R707 in parallel with a portion of potentiometer R706. This results in diode CR703 clipping at a more negative voltage point on the modulation pulse. During any operating mode but amplitude modulation (pulse or square wave), the SYNC SELECTOR switch (S102) opens the cathode of V701, and thus disables the Klystron Modulator.

4-37. KLYSTRON MODULATOR (620B). The Klystron Modulator (Figure 4-12) is comprised of tube V701 and associated parts. The modulation pulse is applied through capacitor C701 to the grid of V701. The output of the Klystron Modulator is developed across plate resistors R703 and R705. Diode CR703 serves as a clipper to limit the amplitude of the pulse applied to the Klystron. When the pulse at the plate of V701 is more positive than the voltage present at the cathode of CR703, the diode conducts and limits the pulse. The voltage at which CR703 conducts is established by the setting of potentiometer R706, part of a voltage divider (R702, R706, R708) connected between the -300 and -1000 volt lines. During any operating mode but amplitude modulation (pulse or square wave),

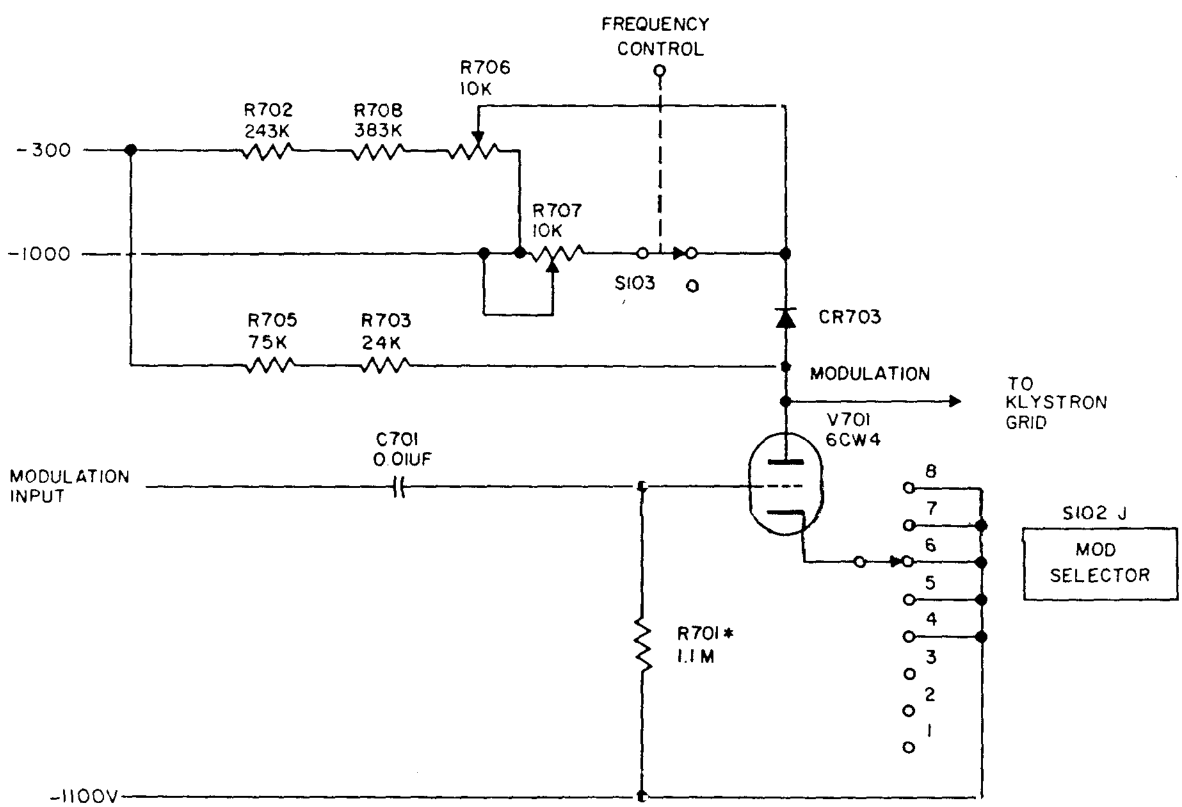


Figure 4-11. Schematic of Klystron Modulator (618C)

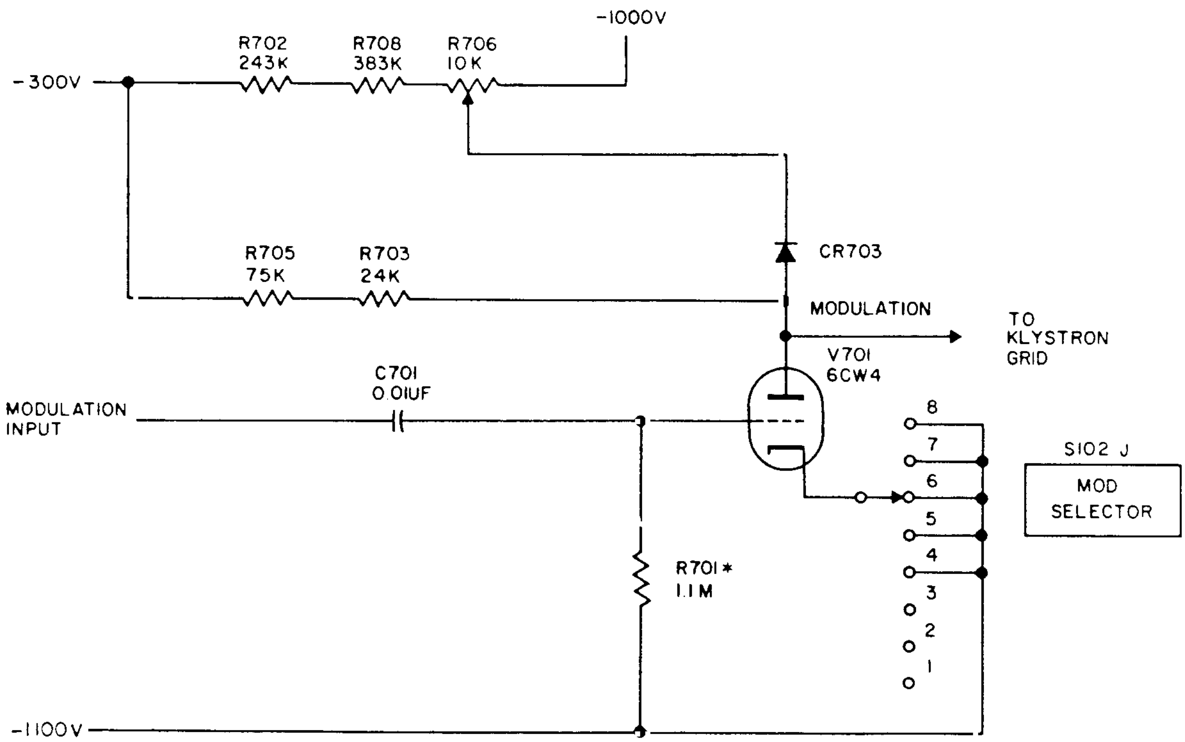


Figure 4-12. Schematic of Klystron Modulator (620B)

the SYNC SELECTOR switch (S102) opens the cathode of V701, and thus disables the Klystron Modulator.

4-38. INTERNAL FM MODULATOR. When MOD. SELECTOR switch S102 is in the FM INT position, the Thyratron Discharge tube comprises a relaxation oscillator (Figure 4-13). This oscillator develops a sawtooth waveform that is applied to the RF Oscillator repeller.

4-39. Capacitors C124, C125, C126, and resistors R146, R147 determine the time constant of the sawtooth

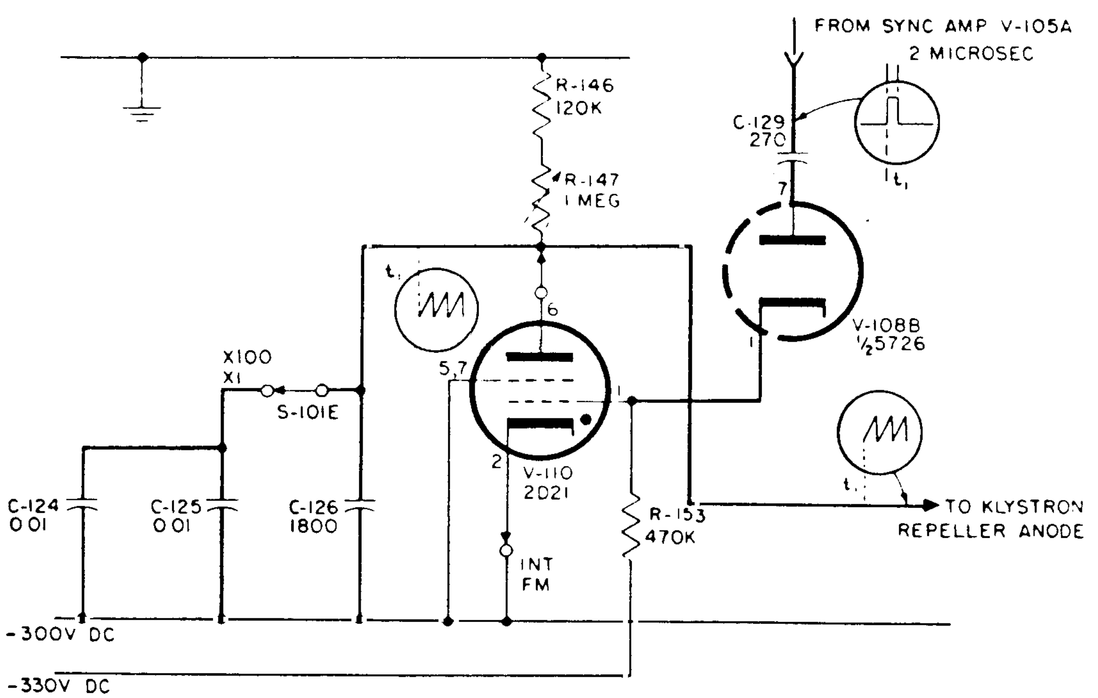


Figure 4-13. Schematic of Frequency-Modulating Circuit

output for the X1 range; while C126, R146 and R147 perform the same function for the X10 range. Resistor R147 is ganged with R111 and R114, and adjusted by the PULSE RATE panel control, so that the FM sweep rate and the internal pulse repetition rate may be controlled by the same control.

4-40. The relaxation oscillator is triggered by a positive pulse from the cathode of the Pulse Shaper and, when activated, delivers a positive-going sawtooth voltage to the repeller, providing frequency modulation.

4-41. THE RF OSCILLATOR.

4-42. REFLEX KLYSTRON. The RF oscillator is a reflex klystron, V114, operating with a tunable coaxial-line resonator. The resonant section is coupled to the resonator grids of the klystron as shown in Figures 4-14 and 4-15 and in the equivalent circuit Figure 4-16.

4-43. Oscillation may be explained by assuming that a small-amplitude RF noise voltage exists across the resonator grids. The electron stream directed through the resonator grids from the cathode is velocity modulated by this small RF voltage. The stream ceases to be uniform, and may be thought of as having some of its electrons accelerated and some retarded. The resultant stream in the drift space past the resonator grids consists of bunches of electrons, and is therefore said to be velocity modulated.

4-44. As this bunched stream (or velocity modulated stream) moves toward the negative-charged repeller it is repulsed back through the resonator grids. Since the stream is bunched, it induces an RF voltage across the grids.

4-45. If the transit time is in phase with the small thermal RF voltage initially assumed to be across the grids, it strengthens the bunching effect on the following stream. Upon reflection, the electron stream following will again strengthen the resonator grid voltage. This process, however, does not continue indefinitely.

4-46. A point is ultimately reached where the fundamental component of the bunching current decreases in magnitude, since energy is now being used to overcome the circuit resistances. There is a point, therefore, where there is just sufficient reflected energy to satisfy the requirements for stable oscillation.

4-47. Assuming that stable oscillation exists when a sudden change in repeller voltage is introduced, the transit time of the electron stream (as it enters and departs the repeller field) is changed. The current bunching effect would change also, and a new RF voltage would be produced across the resonator grids. This velocity modulation then changes the circuit oscillating frequency.

4-48. The situation previously described is valid for relatively small variations in repeller voltage. Excessive variations alter the relationship between the resonator voltage and the transit time of the electron stream, producing dead spots (no oscillation) or conditions of oscillation in undesired modes.

4-49. The term mode, in this sense, describes two different but interrelated characteristics. One mode is the characteristic of the cavity (or line-section resonator), which is resonant at a series of frequencies when the effective electrical length of the line is 1/4 wavelength, 3/4 wavelength, or 5/4 wavelengths. These effective electrical lengths are termed resonator modes.

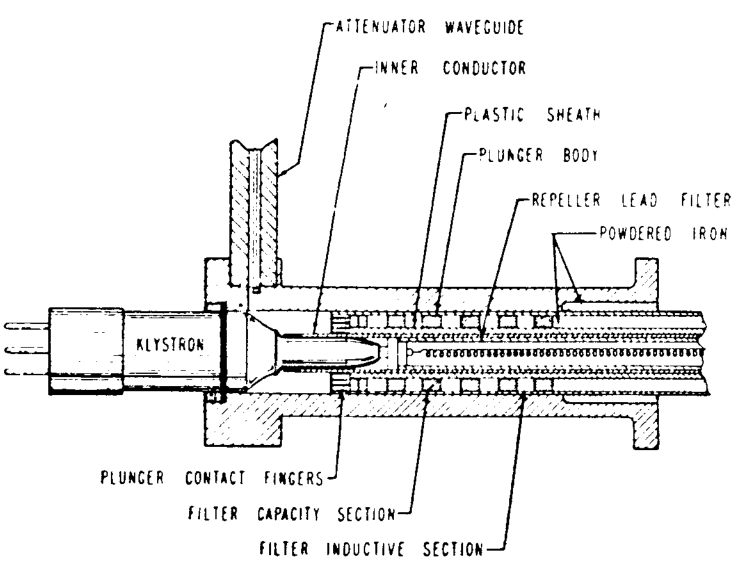


Figure 4-14. Cross-Section of RF Oscillator (620B)

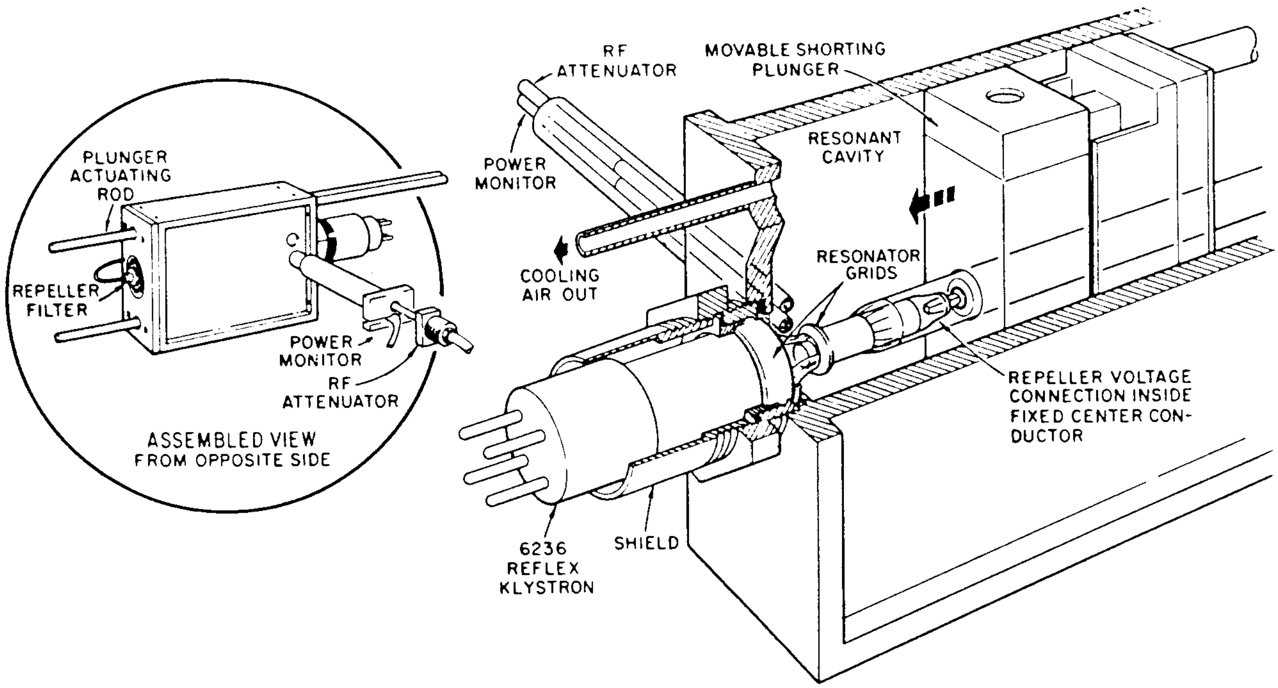


Figure 4-15. Cross-Section of RF Oscillator (618C)

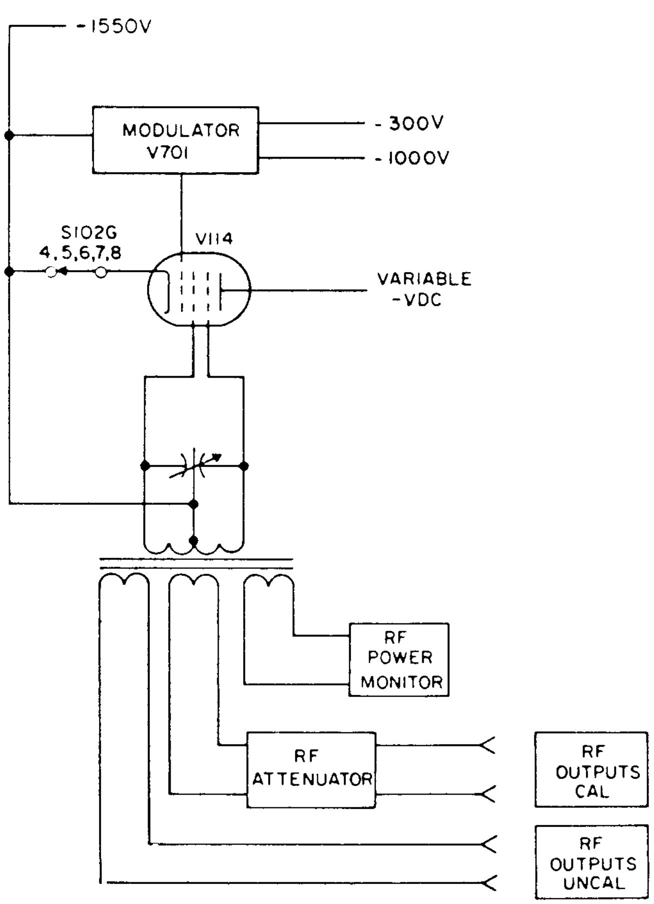


Figure 4-16. Equivalent Circuit of RF Oscillator

4-50. Another mode is the repeller mode, which describes the round-trip transit time of the electron stream as expressed in the cycles of RF voltage across the resonator grids. Oscillations most easily occur when the transit time equals 3/4, 1-3/4, 2-3/4, 3-3/4, 4-3/4 . . . RF cycles. These repeller modes are distinguished by different transit times rather than by different resonant frequencies, and they are functions of repeller voltages. Generally, the value of the repeller voltage increases for a given mode as the mean klystron frequency is increased.

4-51. When a specific repeller mode is desired throughout a given band of frequencies, the repeller voltage is adjusted against the plunger travel (of a tunable resonator, for example) to maintain the relative transit time. Since the repeller mode is a function of transit time, it also remains constant.

4-52. A third use of the term mode is the oscillation mode, which is defined in terms of the repeller mode and the cavity mode. For example, an oscillation mode might be 3/4 wavelength cavity and 3-3/4 wavelength repeller.

4-53. REPELLER VOLTAGE CONTROL (618C). The operating characteristics of a reflex Klystron are such that an optimum value of repeller voltage exists for each operating frequency. This voltage is the value that will cause the bunched electrons to return to the resonator grids at the proper time. Figure 4-17 shows the repeller voltage characteristics for the Klystron over the range employed in the Signal Generator.

4-54. The repeller voltage characteristic shown in Figure 4-17 provides for operation in the 2-3/4 repeller mode. The required voltage for optimum operation

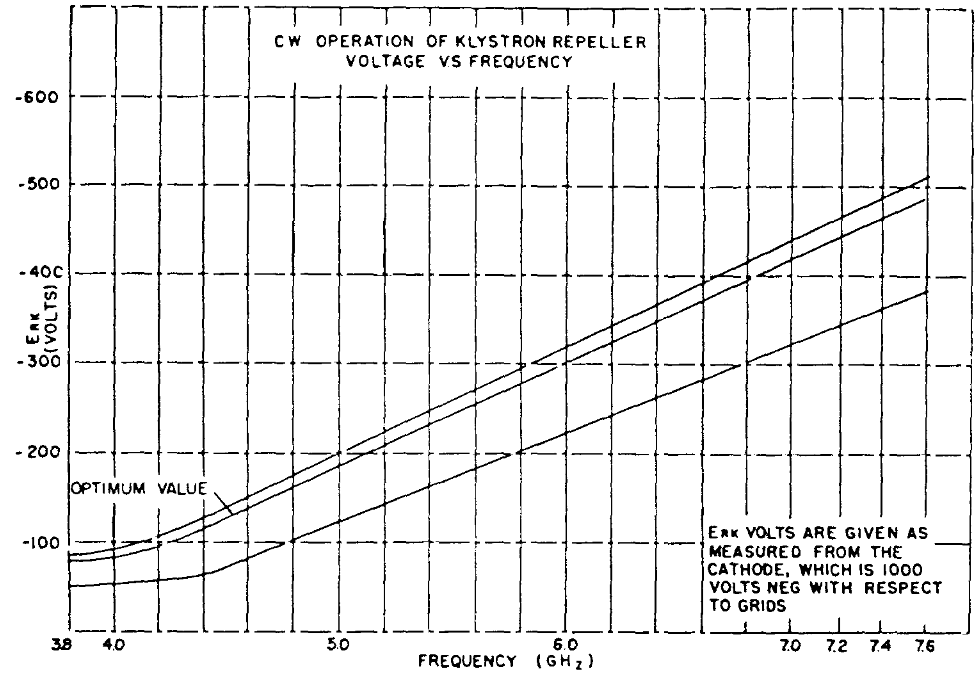


Figure 4-17. Repeller Voltage Versus Frequency (618C)

is essentially linear with frequency for the frequency range above 4400 MHz. In the frequency range from 3800 to 4400 MHz the required voltage is not a linear function of frequency but is slightly curved as shown.

4-55. Figure 4-18 shows the 618C circuit that provides negative voltage to the repeller. Potentiometer R174 is a 100,000-ohm wirewound potentiometer that is mechanically ganged with the mechanism that tunes the resonant line, providing a proper voltage to the repeller electrode as the frequency is changed. The values of the resistor R170 and R175 are adjustable to establish the voltage applied across the tracking potentiometer, R174. The values of resistors R173 and R178 are adjustable to provide the required curvature in the repeller voltage characteristic below 4400 MHz.

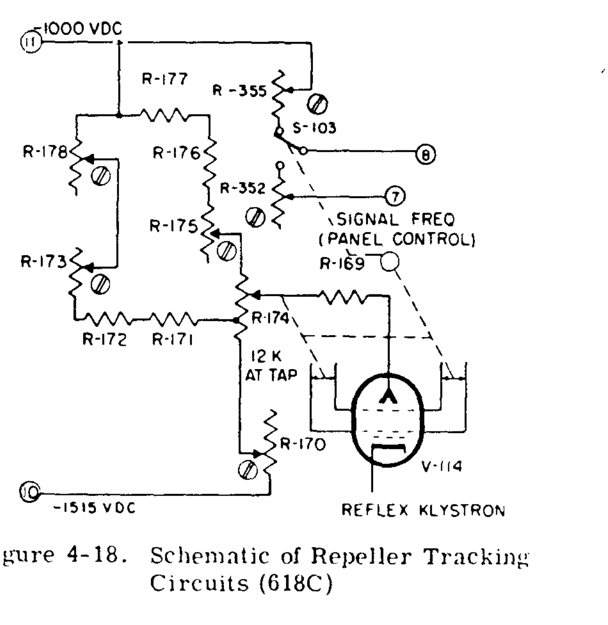


Figure 4-18. Schematic of Repeller Tracking Circuits (618C)

4-56. The ΔF control, R523, is part of a voltage-divider network (R520-R525) that parallels the klystron. Variation of R523 causes small changes in the klystron repeller voltage and thus small changes in the frequency of oscillation.

4-57. PARALLEL-PANEL RESONATOR (618C). The resonator employed in the Model 618C is known as a parallel-plane resonant line. In its physical shape it resembles a rectangular box type cavity with a circular center element and a rectangular plunger to vary the cavity depth. Actually, the line is a direct development from a circular coaxial line as shown in Figure 4-19.

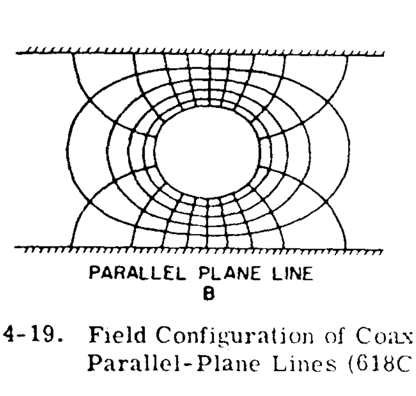


Figure 4-19. Field Configuration of Coaxial and Parallel-Plane Lines (618C)

Part A of Figure 4-19 shows such a line, and the field configurations that exist when it is excited electrically. The resonant frequency of such a line with one end shorted is determined by its electrical length in a direction parallel to the center conductor. The other dimensions of the line play a very small part in determining the oscillating frequency.

4-58. The evolution of the parallel-plane line from the coaxial line may be described by reference to Figure 4-19, parts A and B. Assume the outer conductor were cut at the points X and the two semi-lines thus created were flattened out as shown by the horizontal dotted lines. The voltage and current configurations would then take the form shown in part B. To carry this example through in complete detail, the cross-section of the center conductor would take a slightly elliptical form of perfect configurations. However, for practical purposes, this is not necessary, and a circular center conductor is used.

4-59. The line, as shown in Figure 4-19, part B, is not enclosed on the short sides, and it is possible to operate it in this manner. However, sides are provided to prevent stray RF leakage currents.

4-60. The parallel-plane line depends, for its resonant frequency, upon its electrical length and consequently may be tuned by simple mechanical means and can be directly calibrated. This type of cavity provides a resonator in which simple and straight-forward methods can be employed to provide broadband suppression of the various parasitic resonances that occur when other physical dimensions approach the frequency-determining electrical dimensions.

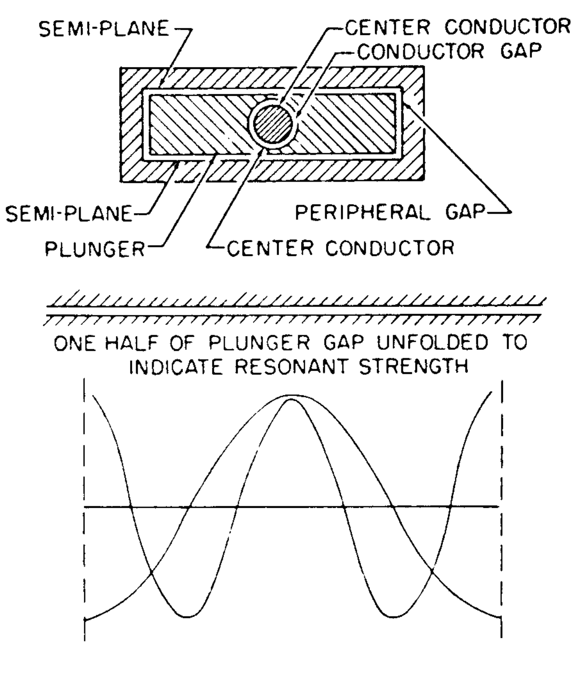


Figure 4-20. Plunger Resonances in Uncompensated Parallel-Plane Line Resonator (618C)

4-61. Figure 4-20 shows a cut-away view of the resonant line and the other components of the parallel-plane oscillator. The klystron is mounted so that one of the resonator grids is coupled to the two semi-lines while the other is coupled to the circular center conductor. The repeller voltage is applied through an insulated filter in the center conductor while the other potentials required to operate the tube are applied through the tube base pins.

4-62. PLUNGER RESONANCE (618C). The plunger employed in the parallel-plane resonator is of the non-contacting type and a small air gap exists between the periphery of the plunger and the surfaces of the semi-planes and sidewalls, as shown in Figure 4-20.

4-63. The gap has a physical length of approximately 17 centimeters, and an electrical length such that it has a two-cycle and a four-cycle resonant frequency occurring near or in the frequency range of the oscillator. As shown in Figure 4-20, these frequencies correspond to one-half and one-quarter of the electrical length of the periphery of the plunger. A similar gap exists between the center conductor and the plunger. However, the length of this gap is such that no resonances occur in the frequency range of the oscillator.

4-64. Compensation is applied to control resonance of the line formed by the peripheral plunger gap in the resonator.

4-65. REPELLER ACTION (620B). As seen in Figure 4-21, the repeller mode for the Model 620B shifts from the 3-3/4 mode to the 4-3/4 mode.

4-66. The 3-3/4 repeller mode is used for the 7- to 9-GHz range, and the 4-3/4 repeller mode is used above 9 GHz.

4-67. The repeller voltage is controlled by a tapered potentiometer ganged to track with the frequency-tuning plunger; it includes a switch which steps the repeller voltage less negative at approximately 8800 GHz to change the transit time to 4-3/4 RF cycles.

4-68. The ΔF control, R523, is part of a voltage-divider network (R520-R525) that parallels the klystron. Variation of R523 causes small changes in the klystron repeller voltage and thus small changes in the frequency of oscillation.

4-69. RESONATOR (620B). The cavity resonator for the klystron is a tunable coaxial line with a shorting plunger. The repeller voltage, plunger, and frequency dial are gang-tuned.

4-70. The resonant frequency for a circular coaxial resonator with one end shorted, is determined by the electrical length of the resonator in a direction parallel to the center conductor. The other dimensions of the line are almost negligible in determining the fundamental frequency of the section.

4-71. UNDESIRED MODE SUPPRESSION (620B). Cavity resonator systems have a tendency to operate in the 1/4-wavelength cavity mode, and from an efficiency and power output standpoint it is

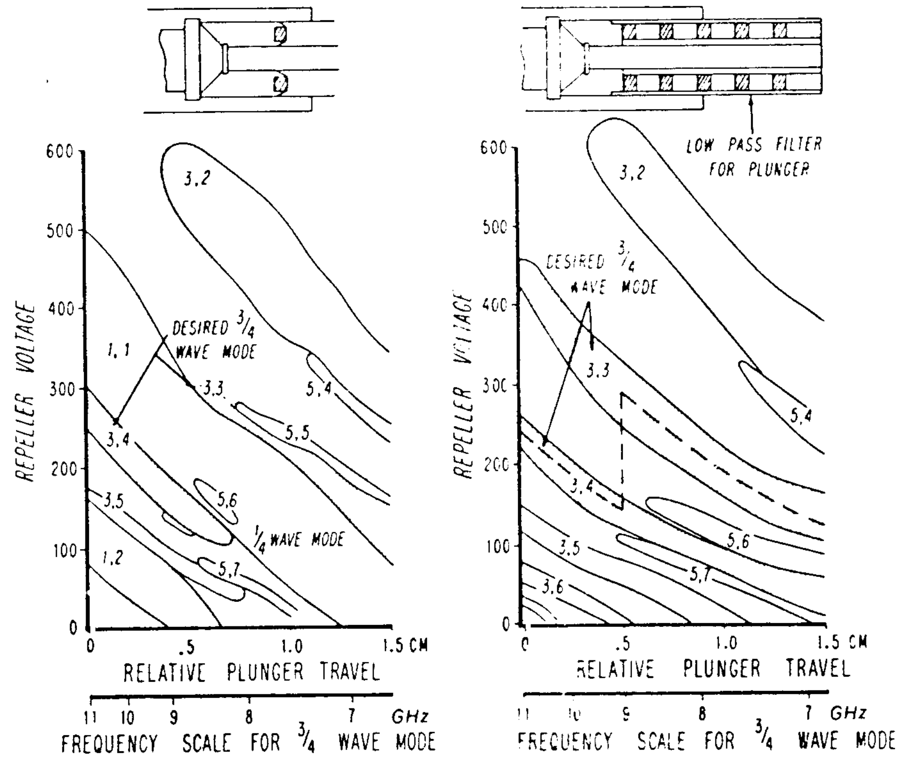


Figure 4-21. Uncompensated and Compensated Mode Structure (620B)

advantageous to operate in the 1/4-wavelength cavity mode. As the desired frequency increases, however, operation in this mode is not always feasible.

4-72. As the desired frequency increases, a 1/4-wavelength becomes quite small and plunger placement in the cavity becomes extremely critical and imposes mechanical limitations, making it necessary to select another mode of operation. The 3/4-wavelength cavity mode is employed for the range of the Model 620B.

4-73. As seen in Figure 4-21 the dominant effects of the 1/4-wavelength mode consist of undesirable mode interference. A study of this 1/4-wavelength cavity and 1-3/4 repeller mode showed that its frequency was below 6000 MHz, considerably below the 7000 MHz low end of the Model 620B. Advantageous use was made of this fact, and the plunger was designed to incorporate a concentric low-pass filter having a cutoff frequency of 6500 MHz.

4-74. PLUNGER CONSTRUCTION (620B). As seen in Figure 4-14, the space between the center conductor of the resonant line and the inner wall of the plunger consists of a number of high- and low-impedance sections in cascade. This constitutes the filter section, which is terminated in back of the plunger with powdered iron to absorb the energy passed by the filter.

4-75. The effectiveness of this approach to the suppression of the undesired mode is seen in Figure 4-21. The filter prevents the undesired mode from supporting itself; the first section of the filter appears as a low impedance for the higher frequencies of the desired modes. In effect, the klystron tube sees a terminated transmission line at frequencies below 6500 MHz. For frequencies above 6500 MHz, the klystron sees a shorted, tunable, high Q resonator.

4-76. The plunger makes contact with the outer conductor wall by means of long-life contact fingers. Peripheral resonances are suppressed by leading the gap between the plunger and the outer wall with a dielectric plastic sheath. The technique effectively lowers the frequency of the parasitics to a range much lower than that of the generator.

4-77. THE ATTENUATOR (618C). Three pickup loops are located in the resonator to collect RF power. The first is the output attenuator loop which couples the calibrated power to be supplied by the generator to the load through an output connector on the panel; the position of this loop is adjustable so that the output power level may be varied as desired. The second is the power level in the oscillating circuit and establishes a reference point to calibrate the output power. The last pickoff loop provides a source of uncalibrated RF power at a front-panel connector.

4-78. Power is coupled to the load from the RF oscillator by a coupling loop located at a suitable point in the resonant line. This loop slides in a circular waveguide section. The cross-section of the waveguide is very small in relation to the frequencies of operation, and normal propagation down the waveguide will not take place. However, some limited propagation does take place, and the power level decreases exponentially as the distance from the resonant line increases. Thus it is possible, by moving a pickup loop linearly in the waveguide, to secure an output that varies in decibels in proportion to the linear travel.

4-79. This type of attenuator is known as an attenuator of the cutoff type and its characteristics are employed so that the pick-up probe and indicating dial can be moved by a simple gear train and the dial may be calibrated directly in decibels.

4-80. A cross-section of the attenuator and RF pick-up loop is shown in Figure 4-22. The RF pick-up loop is terminated by a special resistor, which is made by coating platinum on a glass bead. This resistor is used to match the attenuator to the output cable, and its dc resistance is approximately 50 ohms.

4-81. The polyiron section on the outside of the probe is designed to absorb power that may leak past the probe in the space between the outer conductor and the waveguide walls.

4-82. THE ATTENUATOR (620B). The attenuator in the Model 620B is direct reading and requires no frequency correction. It is essentially a piston probe sliding in a waveguide beyond cutoff.

4-83. Theoretically, the high frequencies beyond cutoff involved in such a waveguide demand dimensions which would be smaller than practical. Consequently the dimensions used have been increased in favor of practical design. Since the dimensions have been increased, there is a slight error introduced because the frequency-versus-attenuation characteristic is not sharp at the cutoff frequency.

4-84. This error is compensated by distributing it over the frequency and the attenuation ranges of the instrument. The compensation is effected by first halving the error by calibrating the attenuator in the middle of the frequency band (approximately 9 GHz). The half-error now exists at the extremes of the band only.

4-85. The net attenuator power-monitor error is less than the maximum error of the instrument, which must allow for the connector mismatches and a source impedance that is not the ideal 50 ohms resistance presented by the pick-up strip on the attenuator probe (Figure 4-23).

4-86. The small dimensions of the waveguide beyond cutoff necessitated careful design of the pickup loops on the power monitor and attenuator probes. The construction details are shown in Figure 4-24.

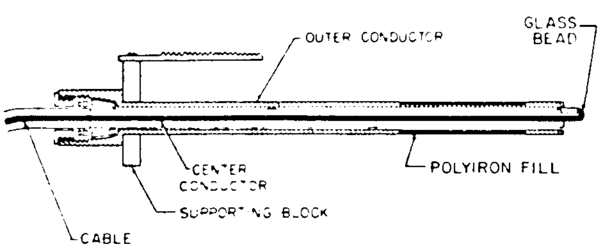


Figure 4-22. Cross-Section View of Attenuator Probe (618C)

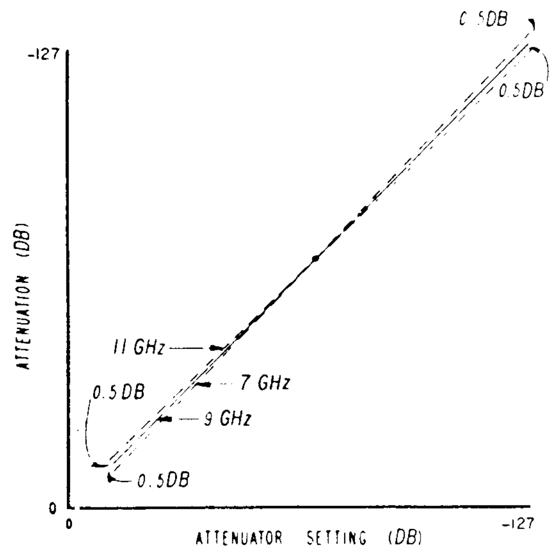


Figure 4-23. Compensation of Attenuator (620B)

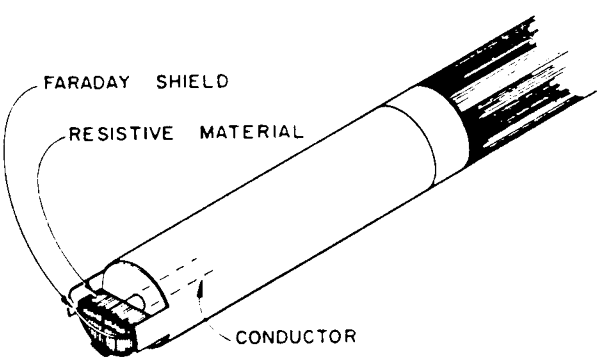


Figure 4-24. Construction Details of Power Monitor Probe (620B)

4-87. THE POWER MONITOR.

4-88. The power monitor circuit is provided to measure and indicate the level of the RF power at the attenuator input.

4-89. The position drive for the attenuator probe is coupled to the calibrated dial, while the drive for the power monitor is coupled to an index which moves around the outside of the calibrated dial. The power monitor probe is nearly a duplicate of the attenuator probe, except that the power picked up by the monitor probe is supplied to a Diode Detector. Figures 4-24 and 4-25 show the 620B power monitor probe. The output of the detector is applied to the Power Monitor Section (Figure 4-26).

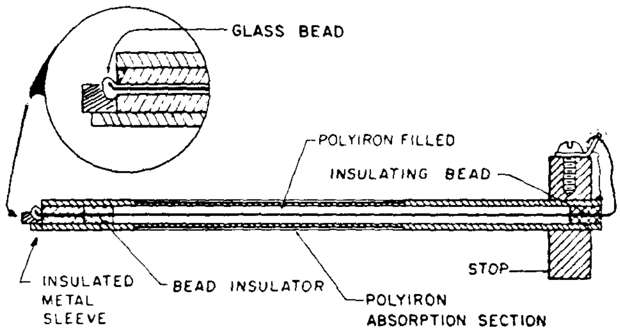


Figure 4-25. Cross-Section View of Power Monitor Probe (620B)

4-90. The Power Monitor Section is composed of a Differential Amplifier acting as a Voltage Comparator. The Differential Amplifier consists of transistors Q601 and Q602 (each a dual-section transistor, with each section in a cascade arrangement), and transistor Q603 acting as a current-feedback generator to increase the input impedance and thus decrease the loading effect on the detected RF signal. The reference input to the differential amplifier is the voltage drop across diode CR602, while the signal to be compared is the detected RF signal. A voltage proportional to the difference in the two input voltages appears between the emitters of Q601A and Q602A, causing the power meter to deflect and indicate the relative power level of the signal Generator output. Potentiometer R612 is the zero-set adjustment for the meter and is adjusted with the MOD. SELECTOR set to OFF (no RF output).

4-91. THE POWER SUPPLIES.

4-92. GENERAL OPERATING PRINCIPLES

4-93. All the dc operating voltages are electronically regulated. Some are obtained directly from regulated supplies, others are derived by voltage division from regulated supplies.

4-94. There are three electronic regulators supplying -300, -1000, and -1550 V. It should be noted that the three power supplies actually develop -300, -700, and -500 V dc; series connection of these voltages results in -300, -1000, and -1550 V. All of the regulators operate as follows. As shown in Figure 4-27, a regulating element (Series Regulator) is connected in series with the load and the dc power source (Rectifier and Voltage Doubler). The resistance of the regulating element is made adjustable so that the voltage at its output will be adjustable. The resistance is adjusted by a control voltage; the higher the control voltage, the higher the output voltage. A sample of the Series Regulator output voltage is compared against a dc reference voltage by a Comparison Amplifier and the difference voltage is inverted and applied to the Series Regulator. As a result, any tendency for the output voltage to change is immediately counteracted by the control voltage, and the supply output voltage remains constant.

4-95. Since the gain of the Comparison Amplifier determines the degree of regulation, it may be followed by an additional Control, or Driver, Amplifier to improve regulation. The Comparison Amplifier is a

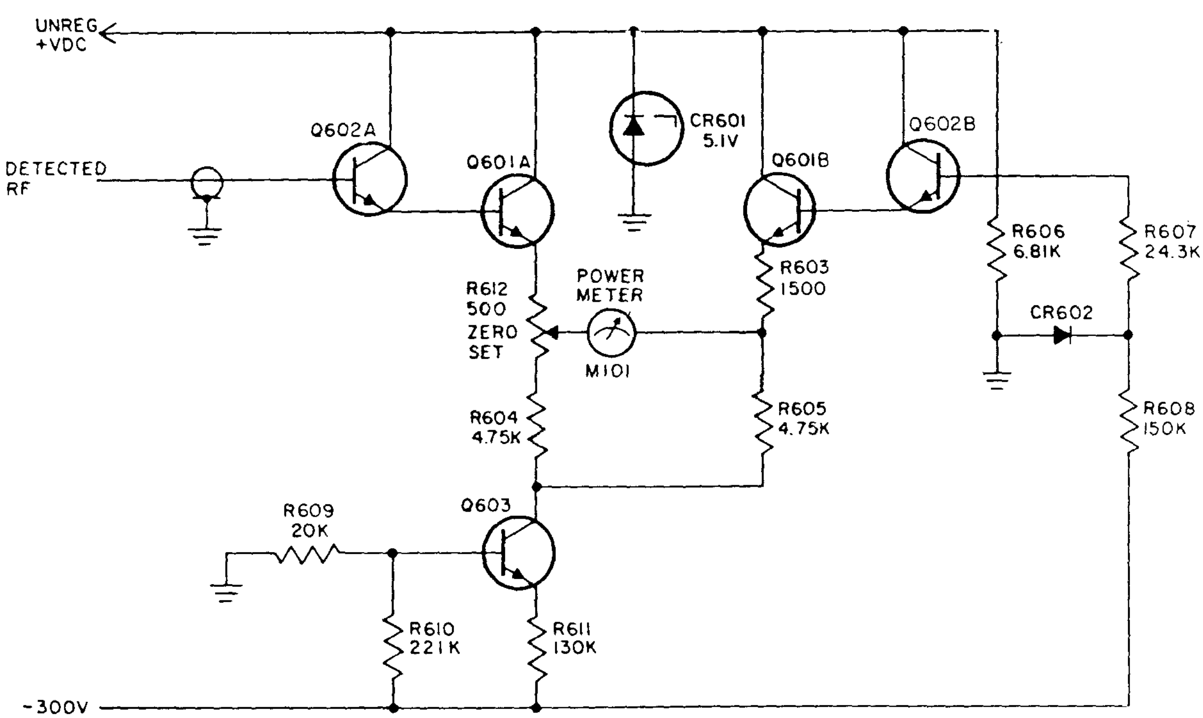


Figure 4-26. Schematic of Power Monitor Circuit

differential type for temperature stability. The dc reference voltage used for comparison is obtained from voltage-regulator electron tubes, from semiconductor voltage-reference diodes, or from another regulated power supply. When an adjustable power supply is used as the reference for another supply, changing its output level also changes the level of the supply for which it is the reference. Consequently, if this reference varies drastically, the output levels of both supplies change.

4-96. -300 VOLT SUPPLY.

4-97. The -300 V supply operates as explained under General Operating Principles. The reference for this supply (applied to the cathodes of V304 through resistor R375) is obtained from the -1000 V supply. In this power supply the Control (Driver) Stage is, like the Comparison Amplifier, a Differential-Type Amplifier.

4-98. -1000 VOLT SUPPLY.

4-99. The -1000 V supply operates as explained under General Operating Principles, and derives its reference from V402. The Comparison Amplifier, V403 and 404, drives the Series Regulator directly. The Regulator receives its screen voltage from regulator tube V305, which, in turn, uses the -300 V supply as a B+ source; consequently, any drastic variation of the -300 V supply will affect the -1000 V supply.

4-100. -1550 VOLT SUPPLY.

4-101. The -1550 V supply operates as explained under General Operating Principles, and derives its reference from V502. The Comparison Amplifier, V503 and V504, drive the Series Regulator directly. The Series Regulator receives its screen voltage from a voltage divider (R514, R515) across the -300 and -1000 V supplies; hence, any drastic variation in either of these two supplies will affect the -1550 V supply.

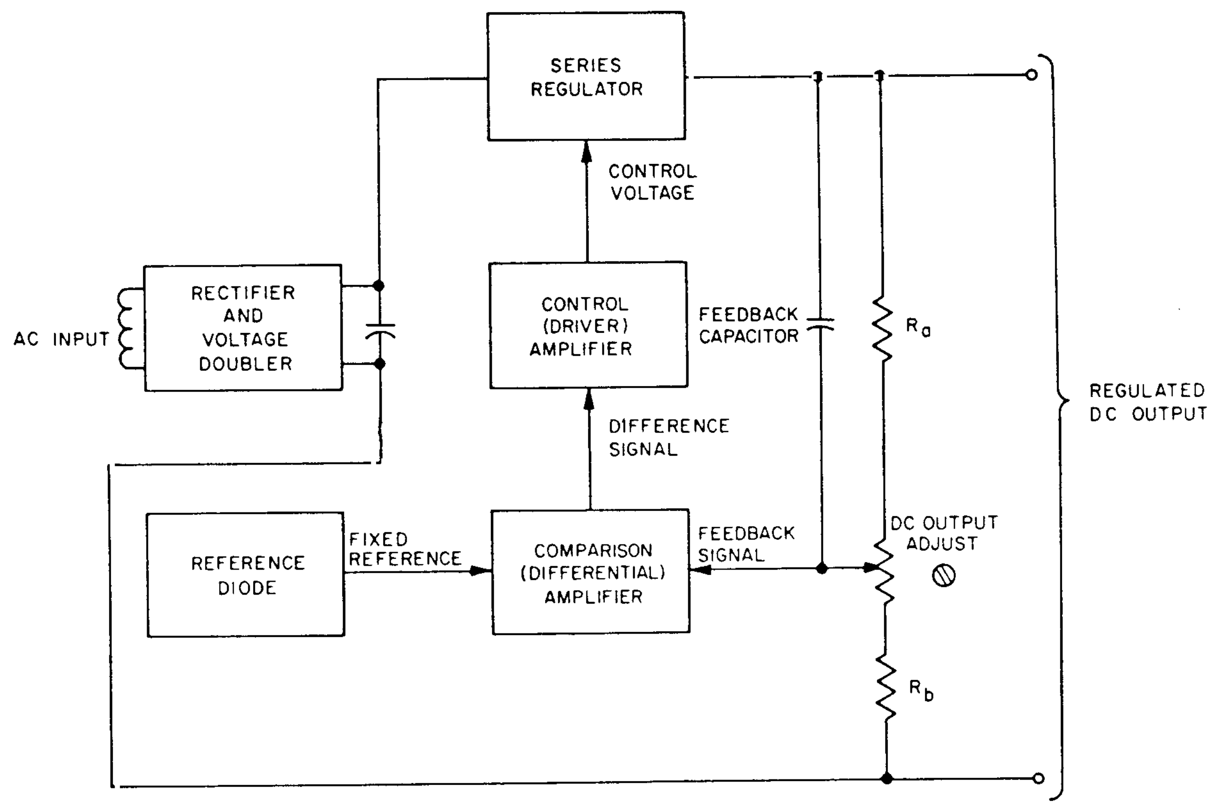


Figure 4-27. Power Supply Block Diagram

Table 5-1. Test Equipment Required for Performance Testing

Instrument	Critical Specification	Recommended Models
Thermistor Mount	Frequency range: 3.8 to 11 GHz SWR: 2.0 max	HP 8481A
Power Meter	Power range: 0 to -30 dBm Accuracy: ±3%	HP 435A
Adjustable Transformer	Output voltage range: 103.5-126.5 and 207-253 volts ac	General Radio W10MT3A
Microwave Frequency Counter	Accuracy: ±1 count ±3 parts in 10^9 Frequency range: 30 Hz to 12 GHz	HP 5342A
Oscilloscope	Vertical sensitivity: 0.05V/cm Bandwidth: 50 MHz	HP 1740A
Crystal Detector	Frequency range: 3.8 to 11 GHz Frequency response: ±0.5 dB per octave SWR: 1.5	HP 423A
Oscillator	Frequency range: 40 Hz to 4 kHz Voltage output: 0 to 10 volts rms Frequency Accuracy: ±2%	HP 200CD
Vacuum Tube Voltmeter	Range: 0 to 10 volts ac Accuracy: ±3% of full scale	HP 410C
Pulse Generator	Frequency range: 1000 Hz Voltage output ±20 and ±70 volts peak Pulse width: 0.5 and 2500 micro-seconds	HP 214B
Spectrum Analyzer	Frequency Range: 3.8 to 11 GHz IF Bandwidth: 10 kHz	HP 8565A

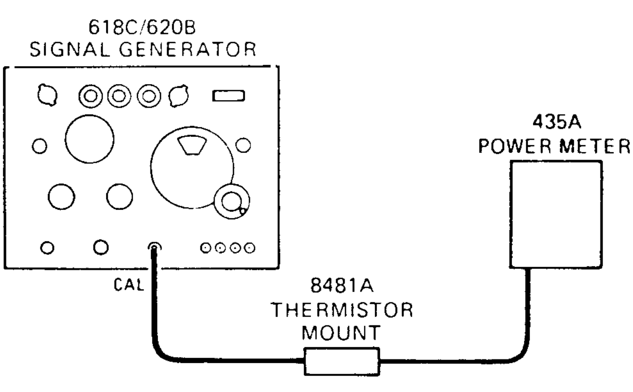


Figure 5-1. Setup for Testing RF Output Accuracy

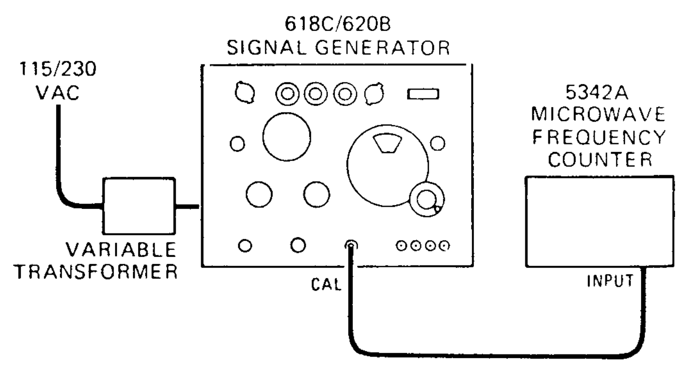


Figure 5-2. Setup for Testing Frequency Accuracy

SECTION V
MAINTENANCE

-1. INTRODUCTION.

5-2. This section provides instructions for performance testing, calibrating, troubleshooting, and reairing the Signal Generator.

5-3. MAINTENANCE PRECAUTIONS.

WARNING

VOLTAGES IN EXCESS OF 1550 VOLTS INSIDE CABINET. USE EXTREME CARE WHEN SIGNAL GENERATOR IS REMOVED FROM CABINET.

5-4. PERIODIC INSPECTION.

5-5. CLEANING.

5-6. If the equipment has been subjected to unusual conditions (excessive moisture, dust, heat, vibration, etc.) it is suggested that the instrument be removed from the cabinet and inspected for dirt or moisture accumulation, loosened components, or any possible gn of damage. Forced air under medium pressure s recommended for dusting and drying, although care must be taken not to vary the settings of the internal-adjustment potentiometers and components during the process. Inspect the air filter regularly and, if necessary, remove and wash in detergent and water. Dry filter and replace: no oiling or coating of the filter is necessary. Unrestricted air flow gives longest component life. Keep the filter clean.

5-7. LUBRICATION.

5-8. No routine lubrication is needed. Lubricate mechanical parts (frequency drive gears, drive mechanism) only when necessary, using a light machine oil. Lubricate moving parts, such as the attenuator and power-monitor probe rack gears, with dry molybdenum or graphite lubricant. The cavity plunger is permanently lubricated during manufacture and requires no subsequent lubrication.

5-9. PERFORMANCE TESTS.

5-10. PURPOSE.

5-11. The following paragraphs check performance for incoming inspection, periodic evaluation, troubleshooting, and calibration. The tests can be performed without access to the Signal Generator interior. The specifications of Table 1-1 are the performance standards.

5-12. TEST EQUIPMENT REQUIRED.

5-13. The test instruments required to make the performance tests are listed in Table 5-1. Test instruments other than those listed may be used provided performance equals or exceeds Critical Specifications.

5-14. RF POWER-OUTPUT ACCURACY CHECK:

a. Connect Signal Generator in test setup shown in Figure 5-1.

b. Set Signal Generator controls as follows:

LINE	ON
MOD. SELECTOR	CW
POWER SET	0
OUTPUT ATTN	0 dB

c. Adjust 618C Signal Generator frequency control from 3.8 to 7.6 GHz; Power Meter should indicate 0 ±3 dBm (reset POWER SET to 0 before each reading).

c. Adjust 620B Signal Generator frequency control from 7 to 11 GHz; Power Meter should indicate 0±3 dBm (reset POWER SET to 0 before each reading).

d. Adjust OUTPUT ATTEN control from 0 to -30 dBm in 1-dB steps; Power Meter indication should agree with OUTPUT ATTEN setting ±3 dBm from 0 to -7 dBm and ±2 dBm from -7 to -30 dBm.

5-15. FREQUENCY ACCURACY, STABILITY, AND ΔFM CHECK.

a. Connect Signal Generator in test setup shown in Figure 5-2.

b. Adjust variable transformer for 115 (or 230) V.

c. Set Signal Generator controls as follows:

LINE	ON
MOD. SELECTOR	CW
Frequency (618C)	3.8 GHz
Frequency (620B)	7 GHz
POWER SET	0
ΔF	Centered

d. Adjust Signal Generator OUTPUT ATTEN control for sufficient output to drive Microwave Frequency Counter.

e. Adjust Microwave Frequency Counter to measure frequency.

f. (618C.) Microwave Frequency Counter shall indicate 3.762 to 3.838 GHz; record indication.

f. (620B.) Microwave Frequency Counter shall indicate 6.930 to 7.070 GHz; record indication.

g. (618C.) Adjust variable transformer for 103.5 (or 207) V; Microwave Frequency Counter indication should be within 0.76 MHz of indication recorded in step e.

g. (620B.) Adjust variable transformer for 103.5 (or 207) V; Microwave Frequency Counter indication should be within 1.4 MHz of indication recorded in step e.

h. (618C.) Adjust variable transformer for 126.5 (or 253) V; Microwave Frequency Counter indication should be within 0.76 MHz of indication recorded in step e.

h. (620B.) Adjust variable transformer for 126.5 (or 253) V; Microwave Frequency Counter indication should be within 1.4 MHz of indication recorded in step e.

i. (618C.) Repeat steps c through h for Signal Generator frequencies of 5.7 and 7.6 GHz. Refer to the following table for proper indications:

i. (620B.) Repeat steps c through h for Signal Generator frequencies of 9 and 11 GHz. Refer to the following table for proper indications:

618C Signal Generator Frequency	Line Voltage		
	115/230	103.5/207	126.5/253
5.7 GHz	5.653-5.7057 GHz	±1.04 MHz	±1.04 MHz
7.6 GHz	7.524-7.676 GHz	±1.52 MHz	±1.52 MHz

620B Signal Generator Frequency	Line Voltage		
	115/230	103.5/207	126.5/253
9 GHz	8.910-9.090 GHz	±1.8 MHz	±1.8 MHz
11 GHz	10.890-11.110GHz	±2.2 MHz	±2.2 MHz

j. Adjust transformer for 115 (or 230) V.

k. Adjust ΔF control to extreme ccw position.

m. (618C.) Adjust Signal Generator frequency control to 3.8 GHz.

m. (620B.) Adjust Signal Generator frequency control to 7 GHz.

n. Measure Signal Generator frequency on Microwave Frequency Counter; record reading.

p. Adjust ΔF control fully cw, and measure Signal Generator output frequency; frequencies measured in this step and step n must differ by approximately 0.5 MHz for 618C; 1.5 MHz for 620B.

5-16. UNCALIBRATED RF OUTPUT CHECK.

a. Connect Signal Generator in test setup shown in Figure 5-1 but connect Thermistor Mount input to RF OUTPUTS UNCAL connector.

b. Set Signal Generator controls as follows:

LINE . . . . ON
MOD. SELECTOR . . . . CW

c. (618C.) Adjust Signal Generator frequency control from 3.8 to 7.6 GHz; Power meter should indicate 0.3 mW minimum over frequency range.

d. (620B.) Adjust Signal Generator frequency control from 7 to 11 GHz; Power meter should indicate 0.3 mW minimum over frequency range.

5-17. INTERNAL PULSE-MODULATION CHECK.

a. Connect Signal Generator in test setup shown in Figure 5-3.

b. Set Signal Generator controls as follows:

LINE . . . . ON
MOD. SELECTOR . . . . INT
SYNC SELECTOR X1
PULSE RATE 40

c. Microwave Frequency Counter should indicate 40 ±10 Hz.

d. Adjust PULSE RATE control to 400; counter should indicate 400 ±100 Hz.

e. Set SYNC SELECTOR to X10; counter should indicate 4000 ±1000 Hz.

f. Adjust PULSE RATE control to 40; counter should indicate 400 ±100 Hz.

g. Adjust PULSE WIDTH control from extreme ccw to cw position and observe Oscilloscope; width of pulses should vary from 0.5 to 10 μs (50% points). Pulse width error should not exceed ±1 μs from 1 through 5 and ±20% from 6 through 10.

h. Set oscilloscope time base for 1 μsec/cm. Adjust the PULSE DELAY control to its extreme CCW position and observe the oscilloscope. Pulse delay should be less than 3 μsec from left side of CRT. Set oscilloscope for 50 μsec/cm and adjust PULSE DELAY control fully CW. Pulse delay should be greater than 300 μsecs.

5-18. INTERNAL SQUARE-WAVE MODULATION CHECK.

a. Connect Signal Generator in test setup shown in Figure 5-3.

b. Set Signal Generator controls as follows:

LINE . . . . ON
MOD. SELECTOR . . . . ⊓⊔
SYNC SELECTOR X1
PULSE RATE 40

c. Microwave Frequency Counter should indicate 40 ±10 Hz and Oscilloscope should indicate symetrical square wave.

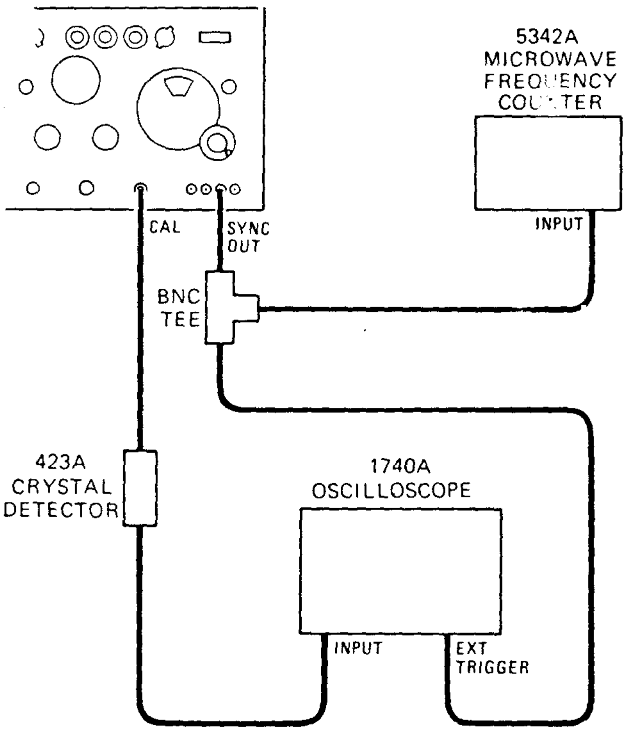


Figure 5-3. Setup for Testing Internal Pulse Modulation

d. Adjust PULSE RATE control to 400; counter should indicate 400 ±100 Hz.

e. Set SYNC SELECTOR to X10; counter should indicate 4000 ±1000 Hz.

f. Adjust PULSE RATE control to 40; counter should indicate 400 ±100 Hz.

5-19. EXTERNAL PULSE CHECK.

a. Connect Signal Generator in test setup shown in Figure 5-4.

b. Set Signal Generator controls as follows:

LINE	ON
MOD. SELECTOR	+EXT
POWER SET	0
OUTPUT ATTEN	0 dB

c. Adjust Pulse Generator for a +20 V peak, 1000-Hz output with a pulse width of 0.5 μs.

d. The Oscilloscope should display 0.5 μs pulses at a 1000 Hz rate switching from 0V to the "on" level (determined by Signal Generator's OUTPUT ATTEN setting).

e. Adjust Pulse Generator for +70V peak output. Display should be the same as in step d.

f. Adjust Pulse Generator for 2500 μs pulses at a 100 Hz rate.

g. The Oscilloscope should display 2500 μs pulses at a 100 Hz rate switching from 0V to the "on" level.

h. Adjust Pulse Generator for +20V peak output. Display should be the same as in step g.

i. Set MOD. SELECTOR to -EXT.

j. Repeat steps c through h with pulse generator adjusted to negative pulse output.

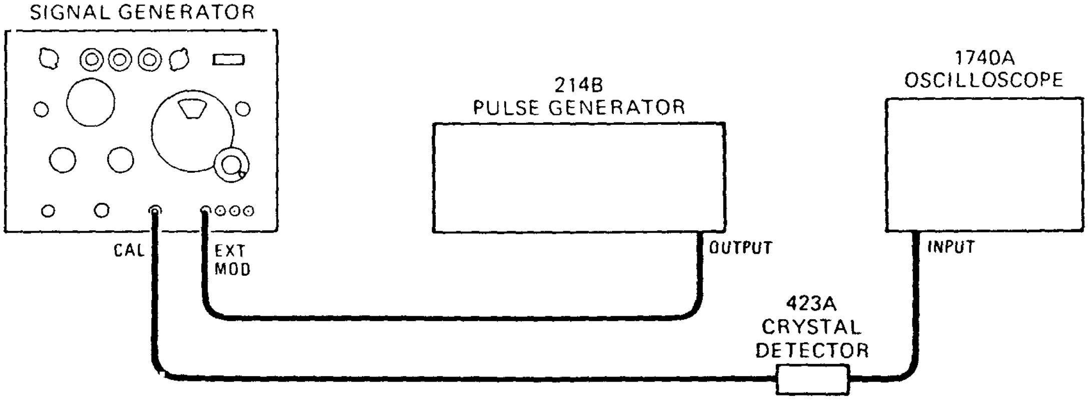


Figure 5-4. Setup for Testing External Pulse Modulation

5-20. INTERNAL FM CHECK.

a. Connect Signal Generator in test setup shown in Figure 5-5 without the oscillator in the setup.

b. Set Signal Generator controls as follows:

LINE	ON
MOD. SELECTOR	INT. FM
Frequency (618C)	5 GHz
Frequency (620B)	7 GHz
POWER SET	0
OUTPUT ATTEN	0 dBm
SYNC SELECTOR	X10
PULSE RATE (1000 pps)	100
FM AMPLITUDE	max ccw

c. Advance FM amplitude control in clockwise direction until the display indicates maximum FM deviation without unstable operation. FM deviation should be 5 MHz p-p minimum.

d. Repeat step c at desired frequencies. FM deviation should be 5 MHz minimum over most of band.

e. Set SYNC SELECTOR to X10.

f. Set PULSE RATE control 50.

g. Repeat steps c and d.

5-21. EXTERNAL FM CHECK.

a. Connect Signal Generator in test setup shown in Figure 5-5.

b. Set Signal Generator controls as follows:

LINE	ON
MOD. SELECTOR	EXT. FM
Frequency (618C)	5 GHz
Frequency (620B)	7.0 GHz
POWER SET	0
OUTPUT ATTEN	0 dBm
FM AMPLITUDE	max ccw

c. Adjust Oscillator output for maximum at 1000 Hz.

d. Advance FM AMPLITUDE control in clockwise direction until display indicates maximum FM deviation without unstable operation. FM deviation should be 5 MHz minimum.

e. Repeat step d at desired frequencies. FM deviation should be 5 MHz p-p minimum over most of the band.

f. Decrease oscillator output and observe FM deviation: FM deviation should decrease proportionally.

5-22. EXTERNAL SINE-WAVE SYNCHRONIZATION CHECK.

a. Connect Signal Generator in test setup shown in Figure 5-6.

b. Set Signal Generator controls as follows:

LINE	ON
MOD. SELECTOR	INT
POWER SET	0
OUTPUT ATTEN	0 dB
SYNC SELECTOR	∿

c. Adjust Oscillator for 40-Hz, 5 V rms input to Signal Generator.

d. Observe Oscilloscope for 40-Hz pulses.

e. Adjust Oscillator for 4000-Hz output; observe Oscilloscope for 4000-Hz pulses.

5-23. EXTERNAL PULSE SYNCHRONIZATION CHECK.

a. Connect Signal Generator in test setup shown in Figure 5-6, but replace Oscillator with Model 214B Pulse Generator.

b. Set Signal Generator controls as follows:

LINE	ON
MOD. SELECTOR	INT
POWER SET	0
OUTPUT ATTEN	0 dB
SYNC SELECTOR	EXT +

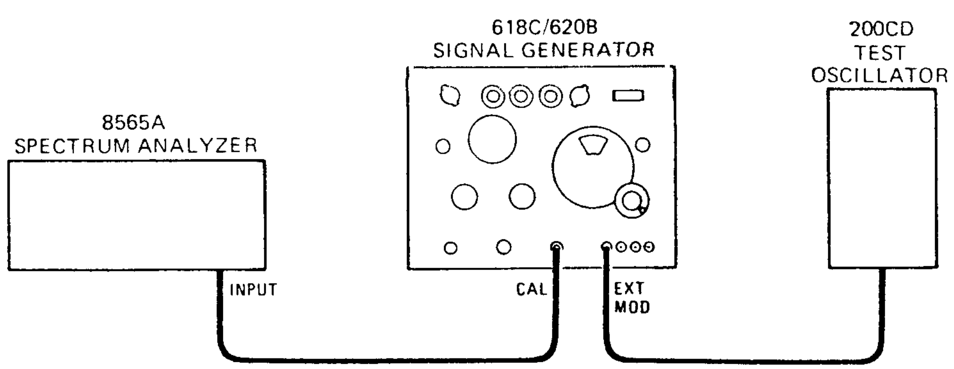


Figure 5-5. Setup for Testing Internal and External FM

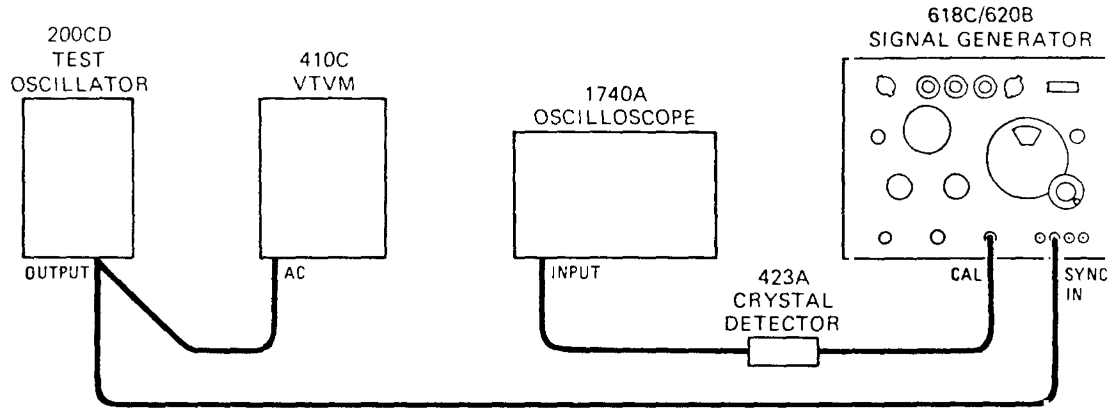


Figure 5-6. Setup for Testing External Sine-Wave Synchronization

c. Adjust Pulse Generator for 10-Hz, +5V peak output with a pulse width of 0.5 μs.

d. Observe Oscilloscope for 10-Hz pulses.

e. Adjust Pulse Generator for +50V peak output; repeat step d.

f. Adjust Pulse Generator for 5-μs pulse width; repeat step d.

g. Adjust Pulse Generator for 4000-Hz output.

h. Observe Oscilloscope for 4000-Hz pulses.

i. Adjust Pulse Generator for 5V output; repeat step h.

j. Adjust Pulse Generator for 0.5-μs pulse width; repeat step h.

k. Set SYNC SELECTOR to EXT-.

m. Repeat steps c through j using negative pulses.

5-24. ADJUSTMENTS.

5-25. TEST EQUIPMENT REQUIRED.

5-26. Test instruments required to perform the adjustments are listed in Table 5-2. Instruments other than those listed may be used provided their specifitions equal or exceed the Critical Specifications.

5-26A. 6.3 Vdc FILAMENT VOLTAGE ADJUSTMENT

WARNING

HIGH VOLTAGE. Measurement points used in this procedure (pins 22-25, 31, and 32) have 1000 volts potential to chassis. Use extreme care when making the filament voltage measurement. The use of a battery powered voltmeter with a plastic case (such as a Simpson 260) is recommended for this measurement. Do not use an ac powered instrument unless the common can be floated at 1000 Vdc and is isolated from the external chassis.

Adjust potentiometer R801 for 6.3 Vdc between pins 31 and 32 (note that pins 22, 23, and 31 are common: pins 24, 25 and 32 are common).

5-27. POWER-SUPPLY VOLTAGE ADJUSTMENTS.

5-28. There are two adjustable voltages: -700 (-1000V supply) and -500 (-1550 V supply) V. Adjust these voltages only if proven by accurate measurement to be outside the tolerances specified below. Adjust the output voltage of the -700 V regulator first and then adjust the -500 V regulator. After adjusting any regulator, check the output voltage of the other regulators to ensure they are within specified tolerances.

a. Connect an adjustable transformer to control Signal Generator line voltage.

b. Set Signal Generator controls as follows:

LINE	ON
MOD. SELECTOR	CW
POWER SET	0
Frequency (618C)	7.6 GHz
Frequency (620B)	11 GHz

Table 5-2. Test Equipment Required for Calibration and Troubleshooting

Test Instrument	Critical Specifications	Recommended Model
All instruments listed in Table 5-1		
Electronic Voltmeter	Range: 0 to 1550 volts Accuracy: ±2%	HP 410C
Clip-On DC Milliammeter	Range: 1 mA to 50 mA Accuracy: ±3% of full scale ±0.1 mA	HP 428B
Frequency Meter	Frequency range: 3.8 to 7.6 GHz (618C) Accuracy: ±0.1%	HP 537A
	Frequency range: 7 to 11 GHz (620B) Accuracy: ±0.1%	HP H532A and X532B
FM Modulator	Output voltage: 300V peak to peak and 6.3 Vac	See Figure 5-32
Voltmeter	Insulated case able to safely float at 1000 Vdc common mode and measure 6.3 Vdc.	Simpson 260

c. Adjust Transformer for 115 (or 230) V.

d. Connect Electronic Voltmeter to test jack J6 (+) and ground (-).

e. Adjust potentiometer R412 (Figure 5-7) for -1000 ±20 volts. Line voltage regulation (115 V ±10%) should hold the -1000 V supply to within ±5V; ripple should be less than 10 mV, p-p. The -300 V supply ould track the -1000 V supply to -300 +10 V. Line tage regulation (115 V ±10%) should hold the -300 V upply to within ±5 V; ripple should be less than 10 mV, p-p.

f. Connect Electronic Voltmeter to test jack J5 (+) and ground (-).

g. Adjust potentiometer R512 (Figure 5-7) for -1550 ±20 V. Line voltage regulation (115 V ±10%) should hold the -1550 V supply to within ±5 V; ripple should be less than 15 mV, p-p.

5-29. ADJUSTMENTS FOLLOWING REPLACEMENT OF KLYSTRON V114 (618C).

5-30. Following replacement of V114, it is important that certain adjustments be made as soon as the Signal Generator is turned on. The following procedure is recommended.

a. With the signal generator removed from the cabinet and with MOD. SELECTOR on OFF, turn on signal generator.

b. Check the -300, -700, and -500 volt supplies (see paragraph 5-27).

c. With the MOD. SELECTOR set to CW, adjust R707 (Figure 5-8) for a klystron cathode current of 25 mA maximum (approximately 15 mA).

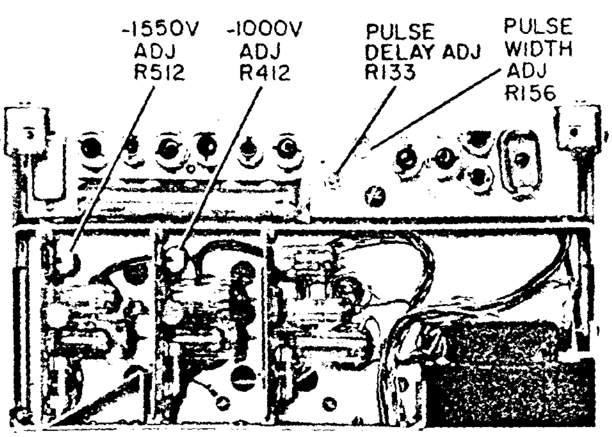


Figure 5-7. Location of Power Supply and Modulator Adjustments

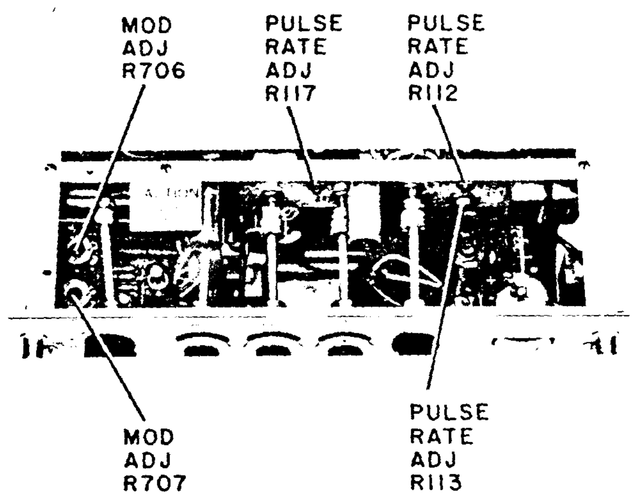


Figure 5-8. Location of Klystron and Modulator Adjustments (618C)

Note

A new klystron tube should now operate at least partially over the frequency range with original repeller voltage settings and for the most part, will require only 1/8 turn to bring the repeller voltage to optimum.

d. Connect instrument as shown in Figure 5-9.

e. Set MOD. SELECTOR to INT. (SYNC SELECTOR to X10). Tune frequency control to 7.6 GHz.

f. Adjust R170 for optimum pulse shape.

g. At this point it is advisable to check the dial calibration at the high end stop. This check avoids possible retracking adjustments when the dial calibration is adjusted later. To conduct the check, tune frequency control to high end stop and place wavemeter in circuit as shown in Figure 5-9. Wavemeter should indicate 7.650 GHz. When the wavemeter is tuned to the actual frequency of the generator a slight decrease in the peak level of the pulse appears on the scale. If this frequency is more than 25 MHz away from 7.650 GHz perform step d in paragraph 5-34.

h. Remove wavemeter and reconnect output cable as shown in Figure 5-9. Tune the frequency control toward 5 GHz, adjusting R170 (Figure 5-11) for best pulse shape between 7.6 and 5 GHz.

i. Tune the frequency control between 5 and 4.2 GHz; adjust R173 and/or R178 (Figure 5-11) for optimum pulse shape.

j. Continue tracking the dial downward toward 3.8 GHz, adjusting R175 for optimum pulse.

k. Tune the frequency control back toward 7.6 GHz observing the pulse shape on the oscilloscope. Readjust the appropriate reflector tracking potentiometer for optimum pulse shape.

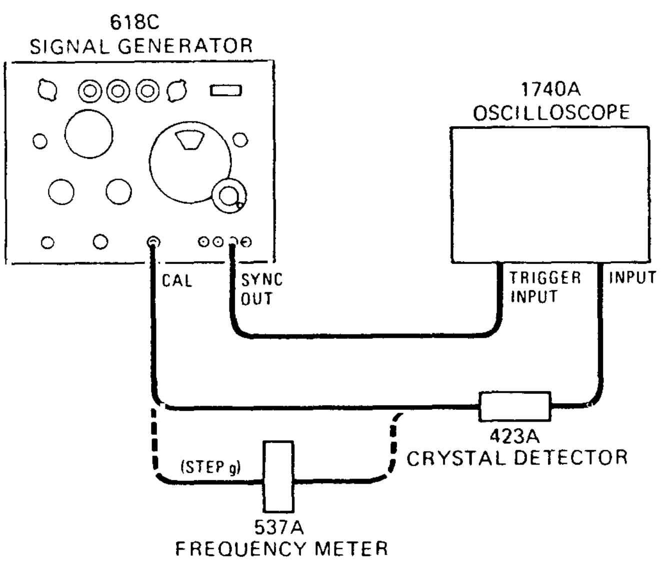


Figure 5-9. Setup for Frequency Dial Calibration (618C)

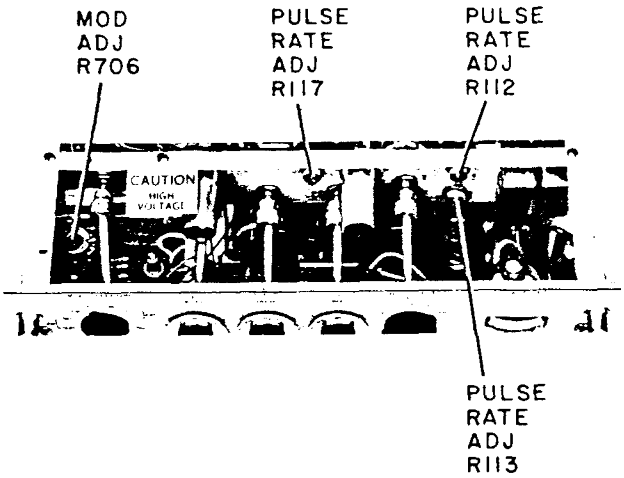


Figure 5-10. Location of Klystron and Modulator Adjustments (620B)

m. If pulse misfiring or jitter occurs at any point in the band which cannot be corrected by adjustment of the reflector tracking potentiometers, adjust R706 for frequencies above the microswitch operation and R707 for frequencies below the microswitch operation.

n. Set the MOD. SELECTOR to SQ. WAVE and observe the waveshape across the band. The waveshape may be improved by repeating the adjustment of R706 and R707 as outlined in step m preceding.

p. Check frequency dial calibration as described in paragraph 5-33.

5-31. ADJUSTMENTS FOLLOWING REPLACEMENT OF KLYSTRON V114 (620B).

5-32. Following replacement of V114, it is important that certain adjustments be made as soon as the signal generator is turned on. The following procedure is recommended.

a. With Signal Generator removed from cabinet set MOD. SELECTOR to OFF and turn on instrument.

b. Check -300, -700 and -500 V supplies, and klystron cutoff bias. Refer to paragraph 5-27 for power supply adjustments.

c. Adjust frequency control to 10 GHz.

d. Set MOD. SELECTOR to CW and measure klystron beam current with 428B Clip-on DC Milliammeter. Adjust potentiometer R706 (Figure 5-10) for 22-mA klystron beam current.

e. Adjust POWER SET control to obtain up-scale indication on the power set meter. If necessary, adjust potentiometer R170 (Figure 5-11) to obtain proper meter indication. Recheck klystron beam current (25 mA maximum).

f. Adjust Signal Generator to a frequency just above the point where the microswitch is actuated (approximately 8.8 GHz).

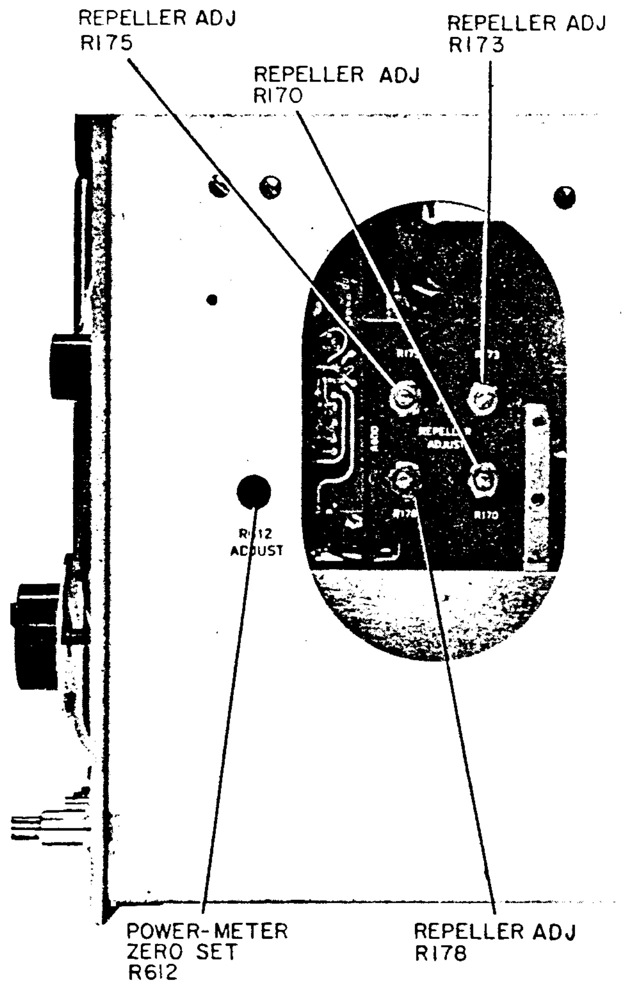


Figure 5-11. Location of Tracking and Power-Set Meter Adjustments

g. Connect Signal Generator in test setup shown in Figure 5-12.

h. Set MOD. SELECTOR to EXT FM and observe repeller mode pattern on Oscilloscope. Adjust OUTPUT ATTEN and external modulating voltage to obtain the desired vertical deflection on Oscilloscope. Adjust FM AMPLITUDE control to obtain humped waveform shown in Figure 5-12. If necessary adjust the phase of repeller mode pattern.

i. Adjust Signal Generator across entire band while observing the repeller mode pattern on Oscilloscope. If the RF power level drops abruptly (in general, between 8.4 and 8.7 GHz), proceed as follows:

(1) Turn off Instrument.

(2) Loosen klystron mounting nut.

(3) Rotate klystron slightly and make sure klystron is seated properly against shoulder in collet.

(4) Tighten klystron mounting nut by hand.

(5) Check to be sure that the repeller cable is not twisted and makes firm connection to repeller.

(6) Turn on Instrument and observe repeller mode patterns on oscilloscope.

Repeat steps (1) through (6) preceding, rotating klystron slightly each time until the optimum repeller mode pattern is obtained across entire band.

j. Turn off Instrument. Set frequency dial at high-frequency stop and tighten klystron mounting nut.

k. Install tube socket housing with cable entrance towards rear of instrument. Replace four screws.

m. Turn on Signal Generator.

n. Measure Signal Generator output frequency with Frequency Meter. If the measured frequency is below 11.1 GHz, remove bottom plate from frequency drive mechanism and perform (1) through (4) following: if not, perform (5) through (9) following:

(1) Loosen plunger cap screw (Figure 5-13).

(2) Adjust Frequency Meter to 11.1 GHz.

(3) Gently tap rear of plunger until Frequency Meter dip is centered on mode pattern.

(4) Tighten plunger cap screw and replace bottom plate.

(5) Set Frequency Meter to 11.1 GHz.

(6) Adjust frequency dial until Frequency Meter pattern is centered on the mode pattern.

(7) Loosen plunger cap screw.

(8) Turn frequency dial to high frequency stop while holding plunger stationary.

(9) Tighten plunger cap screw and replace bottom plate.

p. Tune Signal Generator across entire band and center repeller mode pattern with repeller tracking potentiometer R170, R173, R175, and R178 (Figure 5-9). Figure 5-12 (A and C) shows two typical mode patterns. Figure 5-12A shows a symmetrical mode pattern that is properly centered by the correct repeller voltage: Figure 5-12B shows the same pattern set off-center by incorrect setting of repeller voltage. Adjust potentiometer R170 and R178 (Figure 5-11) to obtain correct repeller voltage tracking between 11 GHz and the frequency just above the point where the microswitch is actuated (approximately 8.7 to 9 GHz). Adjust potentiometers R173 and R175 (Figure 5-11) to obtain correct repeller voltage tracking between the frequency just below the point where the microswitch is actuated (approximately 8.6 GHz) and 7 GHz.

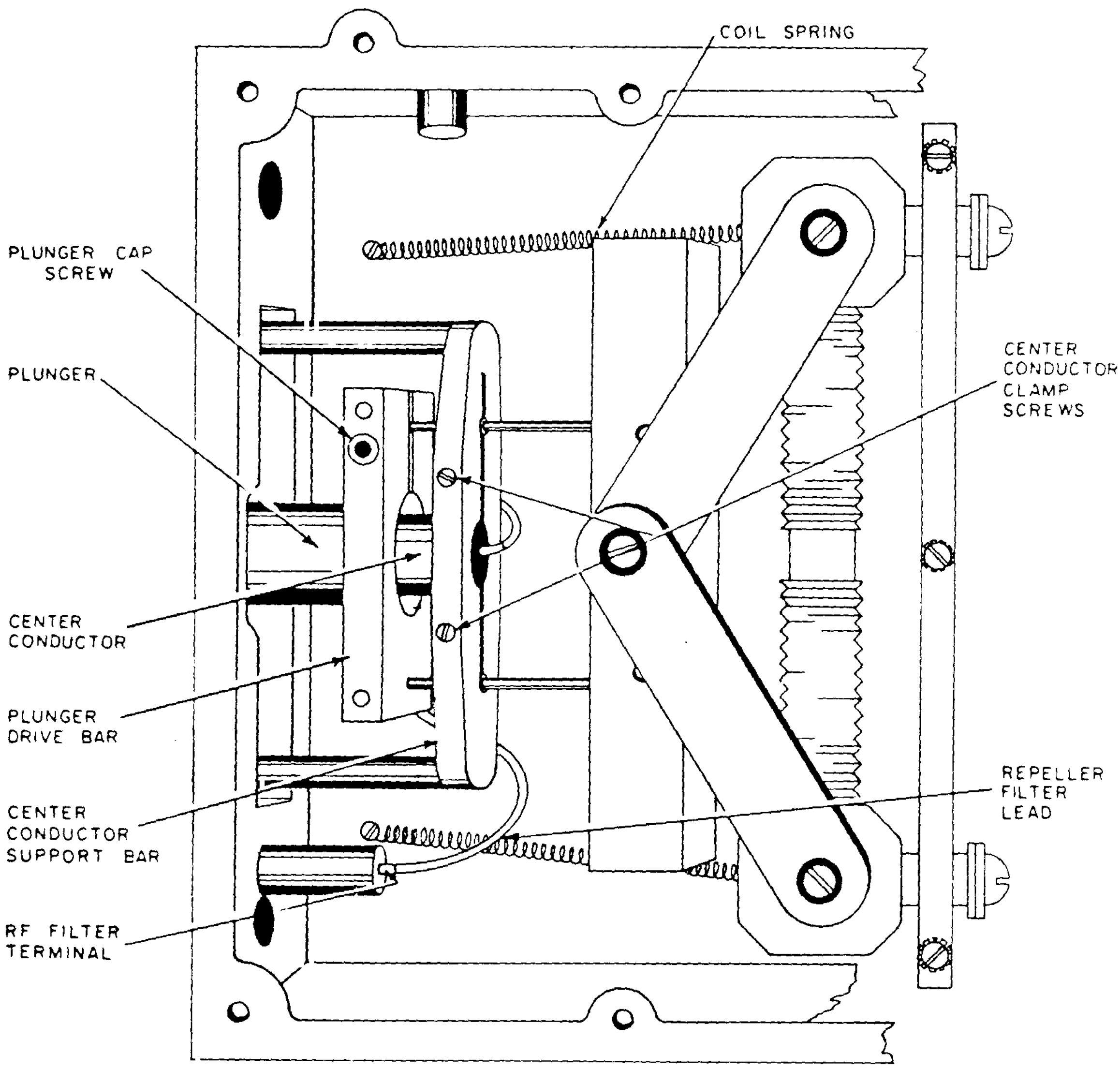


Figure 5-13. Frequency Drive Mechanism, Cover Plate Removed (620B)

5-35. CALIBRATING THE FREQUENCY DIAL (620B).

5-36. Replacing the klystron will usually reduce the accuracy of the frequency dial by several percent from its rated accuracy of 1 %. If accuracy of frequency dial calibration is important, the following procedure can be used to restore accuracy. In general, when a new klystron oscillator tube is installed it is necessary to slip the frequency dial slightly to bring it into calibration. In some cases, it may also be necessary to reset the plunger depth to re-establish the correct high-frequency limit. All adjustments for frequency recalibration must be done mechanically. To recalibrate the frequency dial following a klystron change proceed as follows:

a. Following initial voltage adjustments (paragraph 5-32), set MOD. SELECTOR to CW and allow Signal Generator to warm up for 20 minutes.

b. Assuming that the repeller adjustments have been set for best operation of the new klystron, tune Signal Generator to the highest frequency at which the klystron will oscillate; measure this frequency with a Frequency Meter.

c. If the klystron cannot be made to oscillate up to 11 GHz, refer to the troubleshooting procedures.

d. If the klystron oscillates satisfactorily up to 11.1 GHz, check the frequency-dial calibration accuracy over the full frequency range. If the dial calibration is too high or too low over the entire range by a nearly equal amount, the frequency dial may be slipped into calibration by removing the frequency dial cover, loosening the dial hub, and turning the dial a small amount.

e. If slipping the dial will not bring both the high and low ends of the frequency dial into calibration, the high end can first be correctly set by altering the depth of the cavity plunger slightly to obtain the correct upper frequency limit and then slip the dial to bring the low frequency end into calibration.

f. To set the high-frequency limit of the klystron by shifting the plunger setting, remove the bottom plate of the frequency-drive casting to expose the plunger mechanism.

g. Adjust the signal generator to produce 11 GHz as read on the Frequency Meter.

h. Refer to Figure 5-13 and loosen the cap screw holding the plunger in the plunger-drive bar.

i. Holding the plunger in the 11 GHz position, adjust the frequency drive for a reading of 11 GHz on the dial. Tighten cap screw.

j. If oscillation stops when the plunger is moved, readjust the appropriate repeller voltage potentiometer to regain oscillation.

k. Recheck low end of frequency range noting frequency dial accuracy. If dial is inaccurate, remove dial cover, loosen hub slightly and slip frequency dial to correct indication.

m. Recheck accuracy of frequency dial at main points across the band. Refine the foregoing adjustments to produce the best overall accuracy.

n. If the frequency spread of a new klystron tube is much greater or less than that of the original tube, it may not be possible to use the original dial for the new tube. In this case, another klystron must be tried or a new frequency dial must be calibrated.

5-37. CALIBRATING THE PULSE RATE CONTROL.

5-38. Replacing Tube V103 or associated components may lessen the accuracy of the PULSE RATE control but will not otherwise affect the performance of the Signal Generator. It should be noted, however, that the calibration of this dial is only approximate. To calibrate the PULSE RATE dial, proceed as follows:

a. Set Signal Generator controls as follows:

MOD. SELECTOR	INT.
PULSE WIDTH	max cw
PULSE DELAY	max ccw
PULSE RATE	max ccw
SYNC SELECTOR	X10

b. Connect Microwave Frequency Counter to SYNC OUT connector.

c. Adjust potentiometer R112 (Figure 5-8) so that the counter indicates 4800 Hz.

d. Set SYNC SELECTOR to X1.

e. Adjust potentiometer R113 (Figure 5-8) so that counter indicates 480 Hz.

f. Set PULSE RATE fully ccw.

g. Adjust potentiometer R117 (Figure 5-8) so that counter indicates 30 Hz.

h. Adjust PULSE RATE control for a counter reading of 200 Hz.

i. Loosen PULSE RATE dial and adjust to a reading of 200.

5-39. CALIBRATING THE PULSE DELAY CONTROL.

5-40. Replacing tube V107 may degrade the accuracy of the PULSE DELAY Control. After replacing V107, the following procedure can be used to adjust the delay calibration. It should be noted, however, that the calibration of the PULSE DELAY dial is intended only to be approximate.

a. Connect the DELAY SYNC OUT terminal to an oscilloscope vertical input.

b. Synchronize the Oscilloscope with signal at SYNC OUT connector.

c. Set PULSE DELAY control to 300 μs.

d. Adjust potentiometer R133 (Figure 5-7) to give a delay of 300 μs as measured on the calibrated Oscilloscope.

e. Set PULSE DELAY control to 50 μs as indicated by Oscilloscope. (The delay is indicated by the interval between the start of the Oscilloscope trace and the leading edge of the delayed sync pulse.) If necessary, slip the PULSE DELAY dial on its shaft to make calibration accurate.

5-41. CALIBRATING THE PULSE WIDTH CONTROL.

5-42. Replacing Tube V111 may lessen the accuracy of the PULSE WIDTH Control. This control is intended to be accurate within 20% or 1 μs, whichever is greater. To calibrate the PULSE WIDTH control, proceed as follows:

a. Connect RF OUTPUTS UNCAL through a Crystal Detector to vertical input of an Oscilloscope.

b. Synchronize Oscilloscope with signal at the SYNC OUT connector.

c. Set PULSE WIDTH control to 10 μs.

d. Adjust potentiometer R156 (Figure 5-7) so that width of pulse of 10 μs as measured on the Oscilloscope.

e. Set the PULSE WIDTH control to 2-μs pulse width on Oscilloscope.

f. If necessary, slip dial to read 2 microseconds.

g. Repeat steps c through f for best overall calibration accuracy.

Note

The width of RF pulse will vary approximately 0.25 μs as the generator is tuned through its RF range. The above adjustments can be made for best accuracy at any desired RF frequency.

5-43. POWER SET METER ADJUSTMENTS.

5-44. MECHANICAL ZERO. Adjust mechanical zero as follows:

a. Remove instrument cover for access to the meter. Lift the white paper sticker that covers the zero adjust. Be sure to replace it when through.

b. Connect shorting lead across meter terminals.

c. With a non-metallic tool, adjust mechanical zero-adjust screw until meter pointer is at left of meter dot and moving towards meter dot; stop adjustment when meter pointer is exactly at dot.

d. Carefully adjust mechanical zero-adjust screw a few degrees to free screw from meter suspension. If pointer moves off dot, repeat step c.

e. Remove shorting lead from meter terminals and replace instrument cover.

5-45. ELECTRICAL ZERO. The electrical zero is set at the factory and requires adjustment only when bolometer circuit components are changed. Adjust as follows:

a. Remove instrument cover for access to R612 (see Figure 5-11).

b. Set MOD. SELECTOR to CW.

c. Adjust POWER SET until meter pointer is about 3 8 inch to the right of zero (0).

d. Set MOD. SELECTOR to OFF.

e. Adjust zero set control (R612) until meter pointer is at the dot at the left end of the scale. Replace the instrument cover.

5-46. TROUBLESHOOTING.

5-47. TEST EQUIPMENT REQUIRED.

5-48. The test equipment required to troubleshoot the Signal Generator is listed in Table 5-2. Instruments other than those listed may be used provided their specifications equal or exceed the critical specifications.

5-49. ISOLATING A TROUBLE TO A CIRCUIT SECTION.

5-50. The troubleshooting procedures are designed to identify the causes of one or more of the following symptoms:

a. Low or no RF output at RF OUTPUTS CAL.

b. RF output normal but abnormal indication on front-panel power meter.

c. No or low amplitude-modulation level.

d. No or little frequency modulation.

e. Modulation frequency, width, or delay abnormal.

f. Poor or no external synchronization.

5-51. Each of the above troubles first requires isolation to a faulty functional section of the Signal Generator. Regardless of the trouble encountered, the power supply voltages should first be checked (see paragraph 5-27). If a power supply is within 4 or 5% of its nominal value, it should not cause any catastrophic trouble. However, a greater deviation from nominal could be suspected as the cause of a near complete failure of a Signal Generator function. If a voltage value exceeds 4% of its nominal level, the power supply should be repaired prior to troubleshooting the other circuits of the instrument.

5-52. POWER SUPPLY TROUBLESHOOTING. Because the individual power supplies are to some extent interdependent, care must be taken to troubleshoot the supplies in a particular sequence. This sequence is as follows: -300 V supply, -700 V supply, -500 V supply, and the 6.3 V filament supplies.

WARNING

Use extreme care when making the filament voltage measurements. One side of each ac supply is connected to a negative high-voltage source. The use of a battery powered voltmeter with a plastic case (such as a Simpson 260) is recommended for this measurement. Do not use an ac powered instrument unless the common can be floated at 1000 Vdc and is isolated from the external chassis.

5-53. To isolate a trouble in the -300 V supply, check the -300 V output at test point 2. Excessive ripple is probably due to a failure of capacitor, C360, C361, C362, or C363, or a heater-cathode short in V301-V304. If the -300 V output is nonexistent or very low, check the dc voltage between test points 2 and 13 to establish that the dc input to the regulator is normal. If normal, the regulator circuit composed of V301-V304 and associated parts is faulty. Isolate the faulty tube or part through voltage and resistance checks (Figures 5-21, 5-22), and tube replacement. It should be noted that the regulator circuit comprises a servo (feedback) loop, and hence a failure of any part will be reflected by erroneous voltage indications at most points in the circuit. Resistance readings, however, usually provide an indication of a faulty part.

5-54. It should be established that an excessive load is not being placed on the power supplies, such as a shorted high-voltage decoupling capacitor or shorted tube. Excessive load conditions gives trouble symptoms similar to those encountered in a power supply failure. A Model 428B Ammeter can be used to check the current load on the supplies. Table 5-3 lists the check points for each supply.

5-55. If the dc voltage input to the regulator circuit is abnormal, check the ac voltage between test points 3 and 4 (see WARNING in paragraph 5-52). If this voltage is normal, voltage-doubler diodes CR301, CR302, or associated filter parts (C360-C362, R361, R362) are faulty. If the ac voltage across test points 3 and 4 is abnormal, transformer T1 or the 115 (or 230) V primary-power circuit is faulty.

Table 5-3. Power-Supply Current Measurements

Test Point*	Current (mA)
Pink lead connected to TB1-5	7 ±1
Red lead connected to TB1-6	2.3 ±0.5
Red lead connected to TB1-7	4.3 ±0.5

*MOD. SELECTOR set to INT PULSE; frequency adjusted to 7.6 GHz (618C); 11 GHz (620B).

Note

The -700 V and -500 V supplies are checked in a manner similar to the -300 V supply, using the particular test points assigned to these supplies. Care must be taken to follow the sequence given in paragraph 5-52.

5-56. NO OR LOW RF OUTPUT. Assuming the power supply to be normal, no or very low RF output could be caused by a faulty RF attenuator probe, or a faulty klystron and associated components. A faulty attenuator probe can be positively identified by adjusting the POWER SET control to obtain a normal indication on the front panel power meter. If the meter indication is normal, the RF attenuator probe is faulty; otherwise the problem is in the klystron or associated circuit parts. The klystron oscillator is best checked by voltage and current measurements. Refer to Figure 5-22 or klystron voltage measurements and paragraphs 5-30 and 5-32 for measurement of klystron beam current. If all measurements are normal, replace the klystron. Abnormal voltage measurements indicate a failure of one or more circuit parts. If an abnormal indication occurs in the klystron repeller circuit, perform resistance measurements to isolate the faulty part. In the klystron grid circuit, perform resistance checks and check modulator tube V701. In the cathode circuit, check diodes CR701 and CR702.

5-57. RF OUTPUT NORMAL BUT RF OUTPUT METER ABNORMAL. This trouble indication is caused by either a faulty power-monitor probe or power meter circuit. A faulty power-monitor probe is detected by removing diode CR603 and measuring the resistance between center conductor and case. Normal indication is 50 ± 5 ohms. If both the probe and detector check normal, perform voltage checks (see Figure 5-22) on transistors Q601 through Q603 to isolate the faulty part in the power meter circuit.

5-58. NO OR LOW AMPLITUDE MODULATION. To identify this type of trouble first establish that the trouble is with all amplitude-modulation modes (internal pulse, external pulse, or internal square wave) or only one of the modes. If all amplitude modulation modes are faulty, Modulator tube V701 or associated circuit parts are probably faulty. This can be checked by performing waveform measurements at test points 14 and 15 (see Figure 5-27). If the abnormal indication is at test point 14 only, check V701 and the plate circuit components. If both test points are abnormal, check V701 and the grid circuit components. Voltage and resistance checks should isolate a faulty part.

5-59. If the trouble involves only internal pulse modulation, the trouble is in MOD. SELECTOR switch S102 or the internal pulse-generating circuits. To isolate the trouble, check the waveforms (Figure 5-27) at test points 22 through 16, (in that order) and refer to the following list of troubles when an abnormal waveform is encountered.

Abnormal Waveform at Test Point	Trouble
22	V102, V103, or associated parts
21	V105 or associated parts
20	S102, deck H; or V106, V107, or associated parts
19	S102, deck F; or V109 or associated parts
18	V108 or associated parts
17	V111 or associated parts
16	S102, deck E

5-60. If only external pulse modulation is faulty, set MOD. SELECTOR to -EXT and check modulation. If normal, inverter V109A is faulty. If abnormal, switch S102 (sections E or G) is faulty, or capacitor C123 or resistor R143 is faulty. The latter two components may be isolated by checking the external modulating signal at test point 23.

5-61. If only square-wave modulation is faulty, perform waveform measurements at test point 22. If normal, switch S102 (deck G) is faulty. If abnormal, V102, V103, or associated parts are faulty.

5-62. NO OR LITTLE FREQUENCY MODULATION. First establish if the trouble is with both external and internal FM. If the trouble is isolated to external FM only, check waveform (Figure 5-27) at test point 23. If waveform at test point 23 is normal, the trouble is in MOD. SELECTOR switch S102, section B or G. If waveform at test point 23 is abnormal, check capacitor C123 and resistor R143. If trouble is with both external and internal FM, perform waveform measurement at test point 24. If waveform at test point 24 is abnormal check capacitor C136 and variable resistor R168. If waveform at test point 24 is normal, perform voltage and resistance measurements (Figures 5-21, 5-22 of the klystron repeller circuit.

5-63. If only internal FM is faulty, place MOD. SELECTOR to INT FM, check waveform (Figure 5-25) at test points 18 and 21. If indication at both test points is normal, perform voltage and resistance measurements (Figures 5-21, 5-22) on V108B, V110, S102 (section B and D) and coupling capacitor C135. If indication at test point 18 is abnormal, check S102, section F. If indication at test point 21 is abnormal, perform voltage and resistance checks (Figures 5-21, 5-22) of V105 and associated circuit parts.

5-64. MODULATION FREQUENCY, WIDTH, OR DELAY ABNORMAL. A trouble involving the frequency of internal modulation is caused by Multivibrator V102, V103 and associated parts. Pulse width troubles are caused by a fault in Multivibrator V111 or associated parts. Pulse delay troubles are caused by a fault in Multivibrator V106, V107 or associated parts.

5-65. POOR EXTERNAL SYNCHRONIZATION. A trouble involving the external synchronization is caused by Amplifier and Inverter V101 and associated parts. To isolate a trouble in the external synchronization to a faulty part, perform voltage and resistance measurements (Figures 5-21, 5-22) of V101 and associated circuit.

5-66. ISOLATING TROUBLE IN TRANSISTOR CIRCUITS.

5-67. The following procedures and data are given to aid in determining whether a transistor is operational. Tests are given for both in-circuit and out-of-circuit transistors.

5-68. IN-CIRCUIT TESTING.

5-69. The common causes of transistor failures are internal short- and open-circuits. In transistor circuit testing the most important consideration is the transistor base-emitter junction. Like the control grid of a vacuum tube, this is the operational control point in the transistor. This junction is essentially a solid-state diode. For the transistor to conduct, the diode must conduct; that is, the diode must be forward biased. As with simple diodes, the forward-bias polarity is determined by the materials forming the junction. Use the transistor symbol on the schematic diagram to determine the bias polarity required to forward-bias the base-emitter junction. The A part of Figure 5-14 shows transistor symbols with terminals labeled. Notice that the emitter arrow conventionally points toward the type N material. The other two columns of the illustration compare the biasing required to cause conduction and cut-off in transistors and vacuum tubes. If the transistor base-emitter diode (junction) is forward-biased the transistor conducts. If the diode is heavily forward-biased, the transistor saturates. However, if the base-emitter diode is reverse-biased the transistor is cut-off. The voltage drop across a forward biased emitter-base diode varies with transistor collector current. For example, a germanium transistor has a typical forward-bias, base-emitter voltage of 0.2-0.3 V when collector current is 1-10 mA, and 0.4-0.5 V when collector current is 10-100 mA. In contrast, forward bias voltage for silicon transistors is about twice that for germanium types: about 0.5-0.6 V when collector current is low, and about 0.8-0.9 V when collector current is high.

5-70. Figure 5-14, part B, shows simplified versions of the three basic transistor circuits and gives the operating characteristics of each. When examining a transistor stage, first determine if the emitter-base diode is biased for conduction (forward-biased) by measuring the voltage difference between emitter and base. When using an electronic voltmeter, do not measure directly between emitter and base; there may be sufficient loop current between the voltmeter leads to damage the transistor. Instead, measure to a common point (e.g., chassis). If the emitter-base diode is forward-biased, check for amplifier action by short-circuiting base to emitter while observing collector voltage. The short-circuit eliminates base-emitter bias and should cause the transistor to stop conducting (cut off). Collector voltage should then shift to near the supply voltage. Any difference is due to leakage current through the transistor and, in general, the smaller this current, the better the transistor. If collector voltage does not change, the transistor may have an internal open or short.

5-71. TESTING TRANSISTORS WITH AN OHMMETER.

5-72. The two common causes of transistor failure are internal short- and open-circuits. Remove the transistor from the circuit (caution with heat) and use an ohmmeter to measure internal resistance. See Table 5-4, for measurement data.

CAUTION

Most ohmmeters can supply enough current or voltage to damage a transistor. Before using an ohmmeter to measure transistor forward or reverse resistance, check open-circuit voltage and short-circuit current output ON THE RANGE TO BE USED. Open-circuit voltage must not exceed 1.5 V and short-circuit current must be less than 3 mA. See Table 5-5 for safe resistance ranges for some common ohmmeters.

5-73. KLYSTRON REMOVAL (618C).

5-74. To remove the klystron oscillator tube V114 from the resonant cavity proceed as follows:

a. Remove the socket housing cap, screws and lock washers (items 1 and 2, Figure 5-15). Pull the housing (3) away until the tube socket is exposed.

b. Pull straight back on the socket until it is free of the tube base. Do not apply lateral pressure when removing socket.

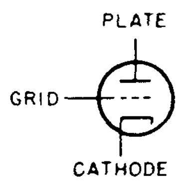
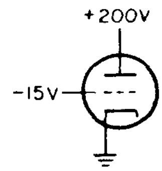
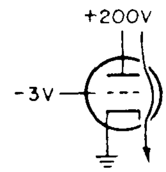
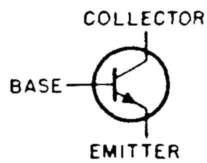
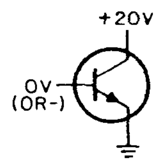
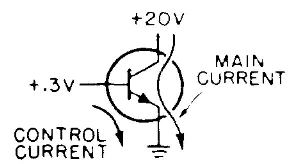
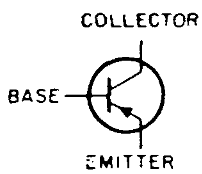
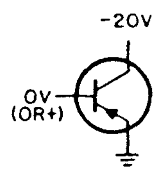
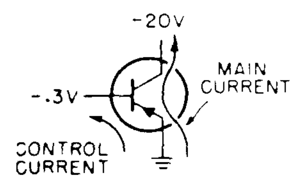
c. Unscrew and remove sleeve (4) which covers klystron body. Do not at any time apply side motion to the klystron: to do so will break the tube.

d. Turn klystron (6) clockwise, and at the same time pull straight back from the cavity. Do not attempt to rock the klystron.

e. Remove rubber washer (14) and clamping ring (5).

f. Unscrew retaining nut (7) at cavity entrance using socket wrench supplied with the instrument. Remove the seating ring (9) and the spring (8) below retaining nut. Do not use this spring or washer again except as a necessity. New springs and washers are supplied with replacement klystrons ordered from Hewlett-Packard Co.

A. TRANSISTOR BIASING

DEVICE	SYMBOL	CUT OFF	CONDUCTING
VACUUM TUBE	 PLATE GRID CATHODE	 +200V -15V	 +200V -3V
N P N TRANSISTOR	 COLLECTOR BASE EMITTER	 +20V 0V (OR-)	 +20V +.3V MAIN CURRENT CONTROL CURRENT
P N P TRANSISTOR	 COLLECTOR BASE EMITTER	 -20V 0V (OR+)	 -20V -.3V MAIN CURRENT CONTROL CURRENT

B. AMPLIFIER CHARACTERISTICS

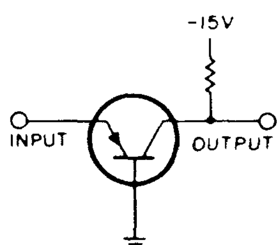
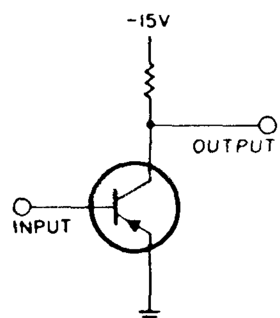
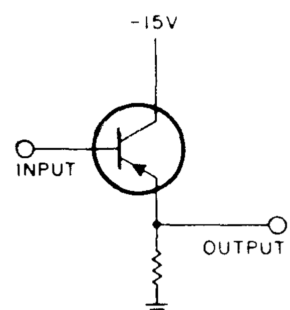
CHARACTERISTIC	COMMON BASE	COMMON EMITTER	COMMON COLLECTOR
INPUT Z	30-50 Ω	500-1500 Ω	20-500K Ω
OUTPUT Z	300-500K Ω	30-50K Ω	50-1000 Ω
VOLTAGE GAIN	500-1500	300-1000	< 1
CURRENT GAIN	< 1	25-50	25-50
POWER GAIN	20-30 dB	25-40 dB	10-20 dB
	 -15V INPUT OUTPUT	 -15V OUTPUT INPUT	 -15V INPUT OUTPUT

Figure 5-14. Transistor Biasing and Operating Characteristics

Table 5-4. Out-of-Circuit Transistor Resistance Measurement

Transistor Type		Connect Ohmmeter: Pos. lead to	Connect Ohmmeter: Neg. lead to	Measure Resistance (ohms)
PNP Germanium	Small Signal	emitter	base*	200-500
		emitter	collector	10K-100K
	Power	emitter	base*	30-50
		emitter	collector	several hundred
NPN Silicon	Small Signal	base	emitter	1K-3K
		collector	emitter	very high (might read open)
	Power	base	emitter	200-1000
		collector	emitter	high, often greater than 1M

*To test for transistor action, add collector-base short. Measured resistance should decrease.

Table 5-5. Safe Ohmmeter Ranges for Transistor Resistance Measurements

Ohmmeter	Safe Range(s)	Open Ckt Voltage	Short Ckt Current	Lead: Color	Lead: Polarity
HP 412A	R x 1K	1.0V	1 mA	Red	+
	R x 10K	1.0V	100 μA	Black	-
	R x 100K	1.0V	10 μA		
	R x 1M	1.0V	1 μA		
	R x 10M	1.0V	0.1 μA		
HP 410C	R x 1K	1.3V	0.57 mA		
	R x 10K	1.3V	57 μA	Red	+
	R x 100K	1.3V	5.7 μA	Black	-
	R x 1M	1.3V	0.5 μA		
	R x 10M	1.3V	0.05 μA		
HP 410B	R x 100	1.1V	1.1 mA		
	R x 1K	1.1V	110 μA	Black	+
	R x 10K	1.1V	11 μA	Red	-
	R x 100K	1.1V	1.1 μA		
	R x 1M	1.1V	0.11 μA		
Simpson 260	R x 100	1.5V	1 mA	Red	+
				Black	-
Simpson 269	R x 1K	1.5V	0.82 mA	Black	+
				Red	-
Triplett 630	R x 100	1.5V	3.25 mA	Varies With Serial Number	
	R x 1K	1.5V	325 μA		
Triplett 310	R x 10	1.5V	750 μA		
	R x 100	1.5V	75 μA		

g. If sample probe adapter (11) protrudes into the cavity, remove the lock nut (12) and disengage pipe (10). Loosen lock nut (12) and back out adapter (11) until it is flush with the inside face of the cavity bottom plate.

Note

See Klystron Tube Warranty Claim in this manual.

5-75. KLYSTRON REPLACEMENT (618C).

5-76. Prior to installing a new klystron V114, practice reinstalling the old one. The proper force and twist required to push the klystron past the spring may then be learned by practice. The procedure for installing the new klystron is as follows:

a. Install new waffle seating ring (9, Figure 5-15) and then new spring (8) in cavity entrance. Ends of spring should meet to form a complete circle.

b. Thread the retaining nut (7) into cavity until it is seated very lightly against the spring. Press spring into place under the nut so that it forms a circle. Tighten the nut slightly to hold the spring in position.

CAUTION

When inserting the tube, always keep it straight in line with the cavity. DO NOT work it from side to side.

c. Insert the klystron tube (6) into the cavity until it engages the spring (8). Firmly press the tube straight into the cavity at the same time giving it a clockwise twist. The twist will cause the spring to expand and pass the tube allowing it to seat firmly in the cavity.

d. Tighten the retaining nut slightly with socket wrench supplied.

e. Snap the clamping rings (5) making certain that they encircle the grid ring of the klystron. When the rings are in position, three or four threads of the nut (7) should be visible between the clamping rings and the outside face of the nut. Install rubber washer (14).

f. Thread the cover sleeve (4) into the retaining nut so that it seats against the clamping rings, causing the clamping ring to grip the grid ring of the klystron. Tighten the sleeve firmly by hand.

g. Install the tube socket and housing (3), pressing the socket straight into position.

h. Position socket housing and attach cap screws (1).

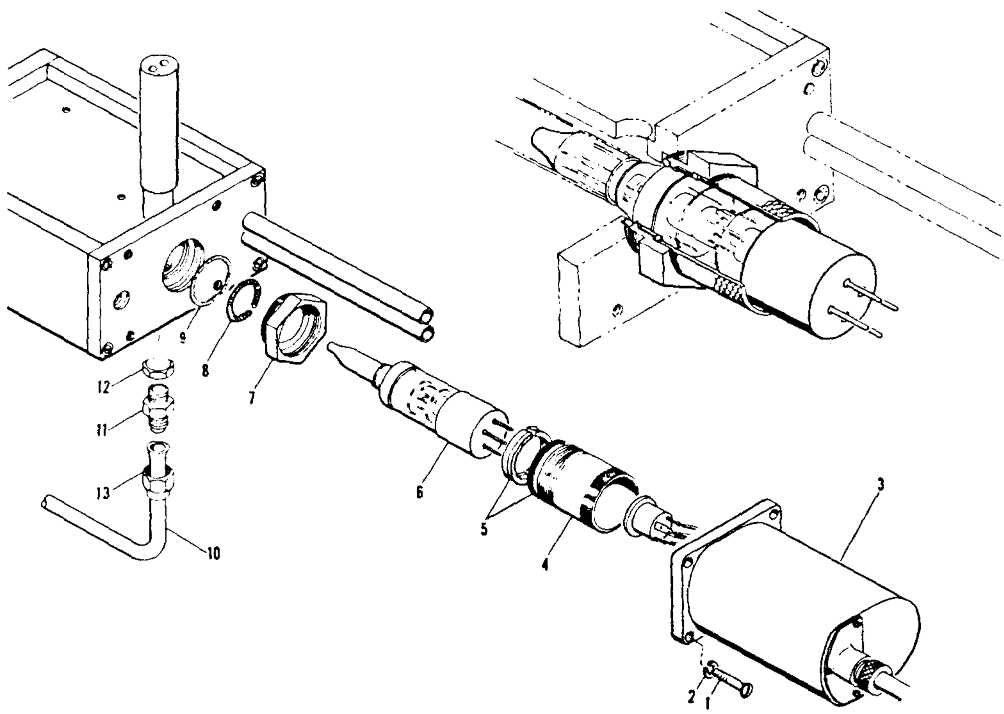


Figure 5-15. Exploded View of Klystron Mounting Parts (618C)

·77. KLYSTRON REMOVAL (620B).

5-78. To remove the klystron from the resonant cavity, remove the Instrument from the cabinet or rack.

The klystron is located at the left side of the instrument just behind the front panel. Refer to Figure 5-16 and proceed as follows:

CAUTION

Do not at any time apply side pressure to the klystron. To do so will break the tube.

a. Remove the four screws from the klystron tube base cover.

b. Pull tube base cover straight out to expose tube base.

c. Remove socket from klystron. Pull socket straight out to expose tube base.

d. Loosen and remove klystron mounting nut with wrench supplied.

e. Remove collet washer with a sharp tool. Grasp klystron tube base and pull straight out of cavity.

f. Remove clamp spring.

g. If collet ring and collet are locked on klystron, place klystron on its base and gently tap collet ring to free the collet.

Note

See Klystron Tube Warranty Claim at rear of Replaceable Parts.

5-79. KLYSTRON REPLACEMENT (620B).

a. Insert waffle washer in cavity (Figure 5-16). Use new washer if old washer is damaged.

b. Place collet ring and collet spring on collet, making sure taper on ring seats against flare of collet.

c. Place collet washer over collet. Place mounting nut over collet washer.

d. Place klystron assembly into cavity and tighten mounting nut by hand until collet just grips klystron, but klystron should still be free to rotate.

f. Slide klystron out approximately 1 8 inch, then push in until klystron seats firmly against shoulder in collet.

CAUTION

DO NOT USE EXCESSIVE PRESSURE, to prevent possible damage to klystron.

g. Tighten mounting nut by hand, then push socket on klystron base, being careful not to exert any side pressure on the klystron.

h. Remove cover plate from frequency drive mechanism to check repeller cable. Be sure to push the repeller cable into center conductor to connect the repeller before turning on the instrument.

h. With an ohmmeter connected between the orange and blue leads on the potentiometer, turn the frequency ntrol to point where microswitch just operates (ap- ›ximately 8.9 GHz), so the arm (blue lead) is exactly . the tap in the potentiometer. This point is the lowest resistance reading on ohmmeter.

i. Replace rear potentiometer cover and reconnect leads.

j. Tighten set screws in the coupler.

k. Reset repeller voltage adjustments as described in paragraphs 5-33 and 5-35.

5-82. REPLACING AND RECALIBRATING THE ATTENUATOR (618C).

5-83. It is not expected that the attenuator dial will require recalibration unless the attenuator assembly is replaced. The attenuator is not ordinarily subject to change or breakage. Small improvements in accuracy may be made by slipping the attenuator dial on the front panel slightly on its shaft to bring into calibration.

5-84. Following replacement of the probe, the attenuator assembly must be adjusted for the correct and safe operating depth. The following instructions are divided into two parts: the first concerns the replacement of the attenuator probe, and the second concerns the attenuator dial alignment.

5-85. REPLACING THE ATTENUATOR PROBE (618C).

5-86. Power from the resonator is coupled to the RF OUTPUTS CAL jack at the front panel through an assembly consisting of the panel jack, a length of RG-55 U cable, and the attenuator probe. The attenuator probe is terminated by a special resistor, which is made by coating platinum on a glass bead. This resistor should normally last for the life of the equipment even if subject to shock and vibration. Should the resistor become broken or otherwise defective however, the complete attenuator assembly must be replaced. Replace a defective attenuator assembly as follows:

a. Remove the four screws holding the RF OUTPUTS CAL connector to the front panel.

b. Release attenuator cable from under cable clamp.

c. Remove mounting screw which holds the rack to the aluminum block on the attenuator probe.

d. Lift mounting block and probe from the circular waveguide housing.

e. Use care in handling attenuator probes. The glass bead resistor can be broken by twisting the cable. Mounting block comes affixed to new probe.

f. Insert new probe into waveguide only as far as is necessary to match-up block mounting holes. Insert mounting screw and tighten. Take care that the probe ground is oriented in the right direction (away from the cavity). The glass beads should be visible on the RIGHT HAND SIDE of the ground connection extension when viewing the instrument from the front.

g. Carefully thread cable under cable clamp and around casting to front panel. Avoid twisting cable more than one-quarter turn.

h. Remount RF OUTPUTS CAL connector. Tighten cable clamp.

i. After the assembly is replaced, an error of a few decibels may exist in the calibration of the attenuator dial.

5-87. RECALIBRATING THE ATTENUATOR (618C).

a. Connect signal generator in test setup shown in Figure 5-1.

b. Turn signal generator on and allow a 20-minute warm up period with modulation selector switch in CW position.

c. Turn modulation selector switch to OFF position, adjust zero set controls in generator and power meter to zero, and return selector switch to CW position. To prevent drift due to temperature change make these adjustments as quickly as possible.

d. Tune signal generator to 3.8 GHz and adjust POWER SET control for zero indication on power set meter.

e. Set attenuator to 7 (-7 dBm). Record frequency and external power meter reading.

f. Repeat step e every 200 MHz across entire frequency range.

g. Plot a dBm-frequency curve from readings obtained in step f (see Figure 5-18). Resulting response curve will consist of a series of peaks and troughs having an amplitude of ±2.0 dB or less. Draw a straight line (parallel to frequency axis) through response curve in such a way that variations are averaged about the line.

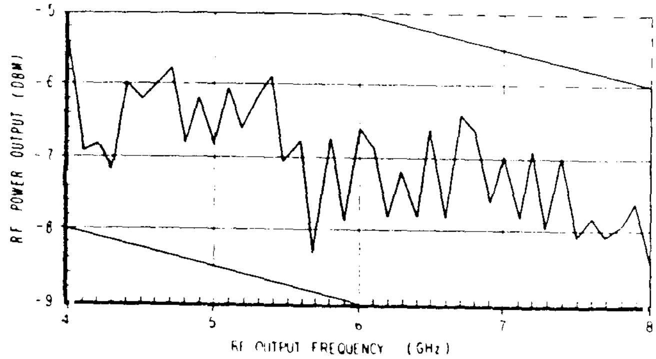


Figure 5-18. Typical Response Curve (618C)

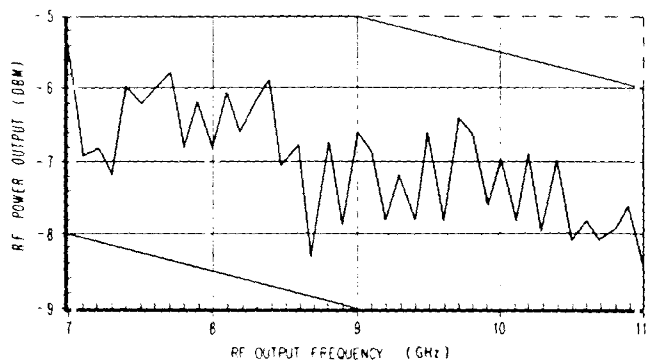


Figure 5-19. Typical Response Curve (620B)

h. Select a frequency where response curve crosses average line drawn in step g and set generator to this frequency.

i. Repeat step c.

j. Set generator output attenuator for -7 dBm reading on power meter and lock attenuator. If attenuator dial does not now read 7 (-7 dBm), remove plate covering hub of dial, loosen set screws holding dial to shaft and slip dial to read -7 dBm. Tighten set screws and replace plate over hub of dial.

k. Repeat steps c and j without changing generator frequency. The readings obtained on external power meter and from output attenuator should be the same. If not, repeat steps c and j until normal indications are obtained.

5-88. REPLACING AND RECALIBRATING THE ATTENUATOR (620B).

5-89. It is not expected that the attenuator dial will require recalibration unless the attenuator assembly is replaced. The attenuator is not ordinarily subject to change or breakage. Small improvements in accuracy may be made by slipping the attenuator dial on the front panel slightly on its shaft to bring into calibration. Following the replacement of the probe, the attenuator assembly must be adjusted for the correct and safe operating depth. The following operation is divided into two parts. The first concerns the replacement of the attenuator probe, and the second concerns the recalibration of the attenuator dial. To determine if the output attenuator is defective, measure the resistance between the center terminal of the RF OUTPUT jack and ground. The resistance should be approximately 50 ohms. A higher resistance indicates the film resistor that composes part of the pickup loop is damaged and the attenuator probe and cable must be replaced.

5-90. REPLACING THE ATTENUATOR PROBE (620B).

5-91. To replace the attenuator probe assembly, proceed as follows:

a. With the signal generator removed from its rack or cabinet and disconnected from the line source, remove nut from rear of the RF OUTPUTS CAL connector and pull attenuator cable from the jack. The center connector and spacing beads are removed with the cable. A new replacement assembly includes these parts already installed.

b. Free the attenuator cable from small clamp and feed cable out top of instrument noting the routing of the cable around the various decks.

c. Mark the attenuator cable where the cable enters the attenuator mounting block. Loosen the cap screw shown in Figure 5-20 on the mounting block holding the attenuator cable. Pull probe straight out.

d. Compare the new probe with the defective probe, marking the new probe at the same distance from the tip as the mark on the defective probe. Insert new probe carefully to the same depth as the original probe making sure that the ground end of the pickup loop points toward the resonator cavity (to the right when facing the Instrument).

e. Tighten cap screw finger-tight so that minor adjustment of the probe depth is still possible.

f. Carefully thread the cable under the cable clamp and around the casting to the front panel. DO NOT twist cable more than a quarter of a turn.

g. Remount RF OUTPUTS CAL connector. Tighten cable clamp.

h. After the attenuator assembly is replaced, an error of a few dB may exist in the calibration of the attenuator dial. Calibration may be checked as described in the following paragraph.

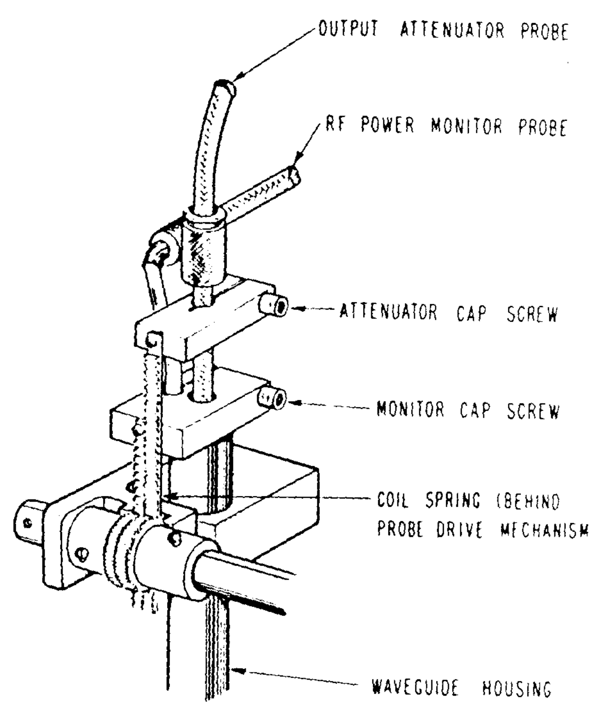


Figure 5-20. Attenuator and Monitor Probe Assemblies (620B)

5-92. RECALIBRATING THE ATTENUATOR (620B).

a. Connect Signal Generator in test setup shown in Figure 5-1. Allow Signal Generator to warm up with MOD. SELECTOR in CW position for at least twenty minutes.

b. Set MOD. SELECTOR to OFF.

c. Adjust Signal Generator to 9 GHz.

d. Connect Power Meter to RF OUTPUT CAL connector; zero meter reading on Power Meter.

e. Set MOD. SELECTOR to CW.

f. Adjust POWER SET control so that the front-panel power meter reads 0.

g. Adjust the OUTPUT ATTEN control to -7 dBm.

WARNING

High voltage is present on the green lead below the attenuator assembly and at the terminals on the potentiometer above the frequency-drive casting. Be extremely careful not to touch these components when adjusting the attenuator probe with the instrument turned on.

h. Gently adjust the probe depth so that the external power meter indicates -7 dBm. Tighten the cap screw on the attenuator probe.

5-93. An initial setting has now been made that will be accurate within approximately ±5 dB. To refine this setting and obtain the original calibration accuracy of ±2 dB it is necessary to measure the output of the signal generator across the frequency range and construct a graph showing the frequency response of the instrument. Figure 5-19 shows such a graph with a typical response curve after the power output curve has been centered about the -7 dBm reference level. The final adjustment is made by slipping the attenuator dial, while measuring the RF output level at a convenient frequency on the curve, to bring the total power spread to be within the ±2 dB limits of the -7 dBm reference level. The limits are indicated by the heavy transverse lines above and below the -7 dBm center line. Proceed as follows:

a. Assuming the Signal Generator is at normal operating temperature, set MOD. SELECTOR to OFF and zero the external power meter.

b. Set MOD. SELECTOR to CW and tune frequency dial to 7 GHz.

c. Adjust POWER SET control so that Meter indicates 0.

d. Check that OUTPUT ATTEN control is set to -7 dBm.

e. Record the reading on the external Power Meter.

f. Repeat steps c through e every 200 MHz from 7 GHz to 11 GHz. Plot the resulting data as a response curve such as the one shown in Figure 5-19.

g. This curve should consist of a series of peaks and troughs with a maximum range of ±2 dBm.

h. Equalize the maximum excursions on each side of -7 dBm by slipping the attenuator dial. The dial is made free of the drive shaft by removing the hub cover from the center of the attenuator dial and loosening the two Allen screws in the periphery of the hub.

5-94. TUBE AND SEMICONDUCTOR REPLACEMENT.

5-95. Table 5-6 lists checks to be made after replacement of certain electron tubes and semiconductors (e.g., diodes, transistors). Replacement of unlisted items does not affect critical Signal Generator functions or operating voltages.

Note

Do not change an operating voltage or calibration adjustment unless it is either definitely outside specified tolerance or calibration accuracy of a dependent function is unsatisfactory. Improving a marginal adjustment can adversely affect calibration.

5-96. ETCHED CIRCUITS.

5-97. The etched circuit boards in the Signal Generator are of the plated-through type consisting of metallic conductors bonded to both sides of insulating material. The metallic conductors are extended through the component mounting holes by a plating process. Soldering can be done from either side of the board with equally good results. Table 5-7 lists recommended tools and materials. Following are recommendations and precautions pertinent to etched circuit repair work.

a. Avoid unnecessary component substitution; it can result in damage to the circuit board and/or adjacent components.

b. Do not use a high-power soldering iron on etched circuit boards. Excessive heat may lift a conductor or damage the board.

c. Use a suction device (Table 5-7) or wooden toothpick to remove solder from component mounting holes. DO NOT USE A SHARP METAL OBJECT SUCH AS AN AWL OR TWIST DRILL FOR THIS PURPOSE. SHARP OBJECTS MAY DAMAGE THE PLATED-THROUGH CONDUCTOR.

d. After soldering, remove excess flux from the soldered areas and apply a protective coating to prevent contamination and corrosion. See Table 5-7 for recommendations.

e. When removing a multiple-connection component held tightly in a socket, such as a vacuum tube, loosen it gradually using gentle side-to-side or rotary motion to avoid damage to the plated-through conductors.

Table 5-6. Checks Following Tube and Semiconductor Replacement

Reference Designation	Check	Paragraphs
V103	PULSE RATE control calibration	5-33
V107	PULSE DELAY control calibration	5-35
V111	PULSE WIDTH control calibration	5-37
V114	Klystron frequency, current and voltage	5-29
V301 thru V305	-300V supply voltage	5-27
V401 thru V405	-1000V supply voltage	5-27
V501 thru V504	-1500 supply voltage	5-27
CR601 thru CR602	Power meter calibration	5-39
Q601 thru Q603	Power meter calibration	5-39

5-98. COMPONENT REPLACEMENT.

a. Remove defective component from circuit board.

Note

Axial lead components, such as resistors and tubular capacitors, can be replaced without unsoldering. Clip leads near body of defective component, remove component and straighten leads left in board. Wrap leads of replacement component one turn around original leads. Solder wrapped connection, and clip off excess lead.

b. Remove solder from mounting holes using a suction desoldering aid (Table 5-7) or wooden toothpick.

c. Shape leads of replacement component to match mounting hole spacing.

d. Insert component leads into mounting holes, and position component as original was positioned. DO NOT FORCE LEADS OF REPLACEMENT COMPONENT INTO MOUNTING HOLES. Sharp lead ends may damage plated-through conductor.

Table 5-7. Etched Circuit Soldering Equipment

Item	Use	Specification	Item Recommended
Soldering Tool	Soldering Unsoldering	Wattage rating: 37.5 Tip Temp: 750-800°F Tip Size: 1/8" OD	Ungar #776 Handle with Ungar #1237 Heating Unit
Soldering Tip, general purpose	Soldering Unsoldering	Shape: chisel Size: 1/8"	Ungar #PL113
De-soldering aid	Unsoldering multi-connection components (e.g., tube sockets)	Suction device to remove molten solder from connection	Soldapult by the Edsyn Company, Arleta, California
Resin (flux) solvent	Remove excess flux from soldered area before application of protective coating	Must not dissolve etched circuit base board material or conductor bonding agent	Freon Acetone Lacquer Thinner Isopropyl Alcohol (100% dry)
Solder	Component replacement Circuit board repair Wiring	Resin (flux) core, high tin content (60/40 tin/lead), 18 gauge (SWG) preferred	
Protective Coating	Contamination, corrosion protection after soldering	Good electrical insulation, corrosion-prevention properties	Krylon® #1302* Humiseal Protective Coating, Type 1B12 by Columbia Technical Corp. Woodside 77, New York

*Krylon, Inc., Norristown, Pennsylvania

5-99. TUBE SOCKET REPLACEMENT. There are three ways to remove a tube socket from the etched circuit boards:

a. Cut terminals attaching socket to circuit board, remove socket, and unsolder remaining terminal pieces individually.

b. Using long nose pliers, break insulating material of socket away from metal connectors, then unsolder connectors from board individually.

c. Use a special soldering iron tip designed to heat all socket connections simultaneously and remove socket as a unit; or use a suction device (Table 5-7) to desolder all connections and remove socket.

5-100. ETCHED CONDUCTOR REPAIR. A broken or burned section of conductor can be repaired by bridging the damaged section with a length of tinned copper wire. Allow adequate overlap and remove any varnish from etched conductor before soldering wire into place.

5-101. TRANSISTOR AND SEMICONDUCTOR DIODE REPLACEMENT.

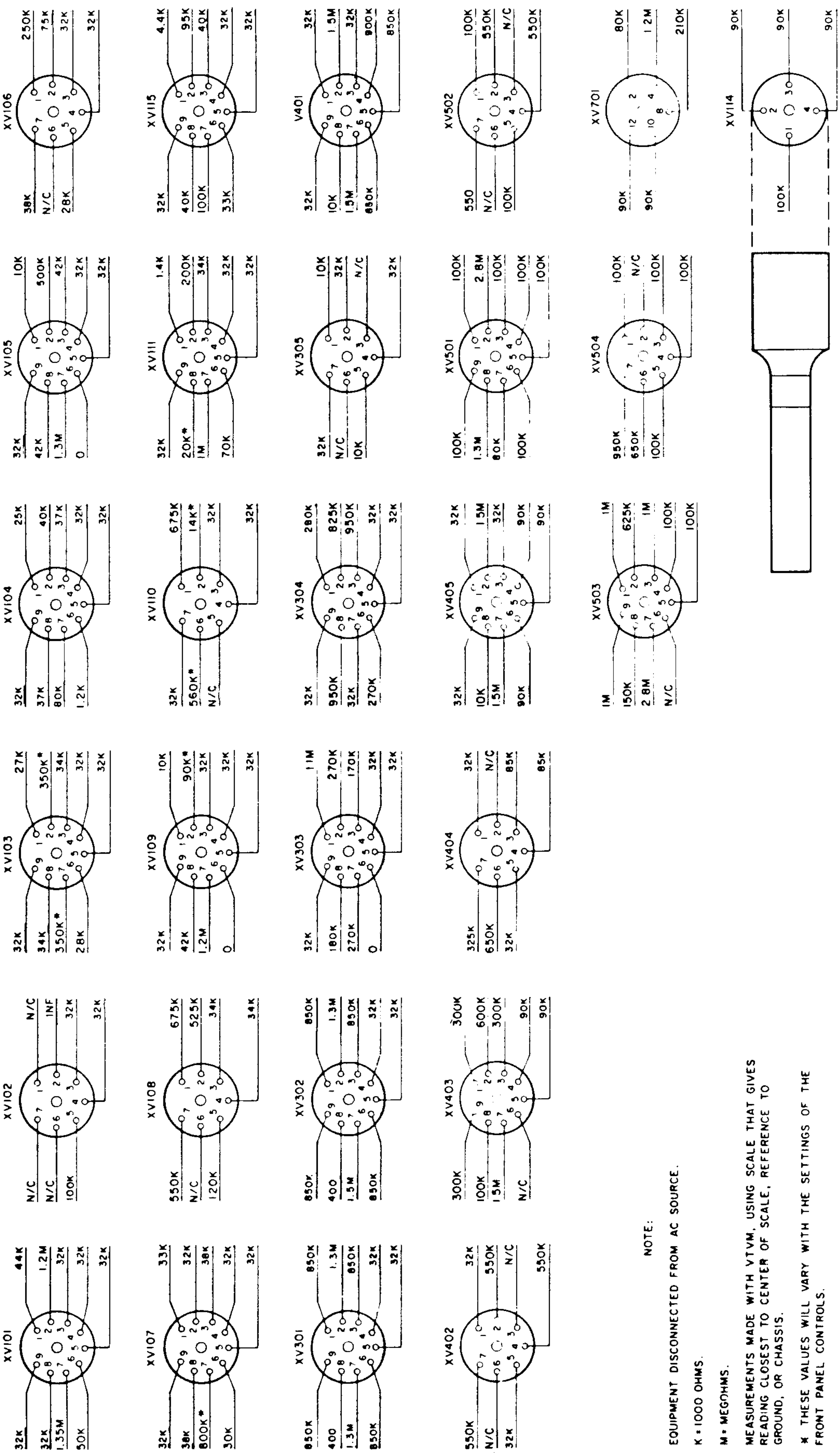
a. Do not apply excessive heat. See Table 5-7 for soldering tool specifications.

b. Use a heat sink such as pliers or hemostat between transistor body and hot soldering iron.

c. When installing a replacement transistor, ensure sufficient lead length to dissipate heat of soldering by maintaining about the same length of exposed lead as used for original transistor.

5-102. Q601, Q602 LEAD IDENTIFICATION.

5-103. Transistors Q601 and Q602 are dual transistors (i.e., two transistors in one case). For this configuration, the locating tab which protrudes from the rim of the transistor case identifies the collector, not the emitter.



NOTE:

EQUIPMENT DISCONNECTED FROM AC SOURCE.

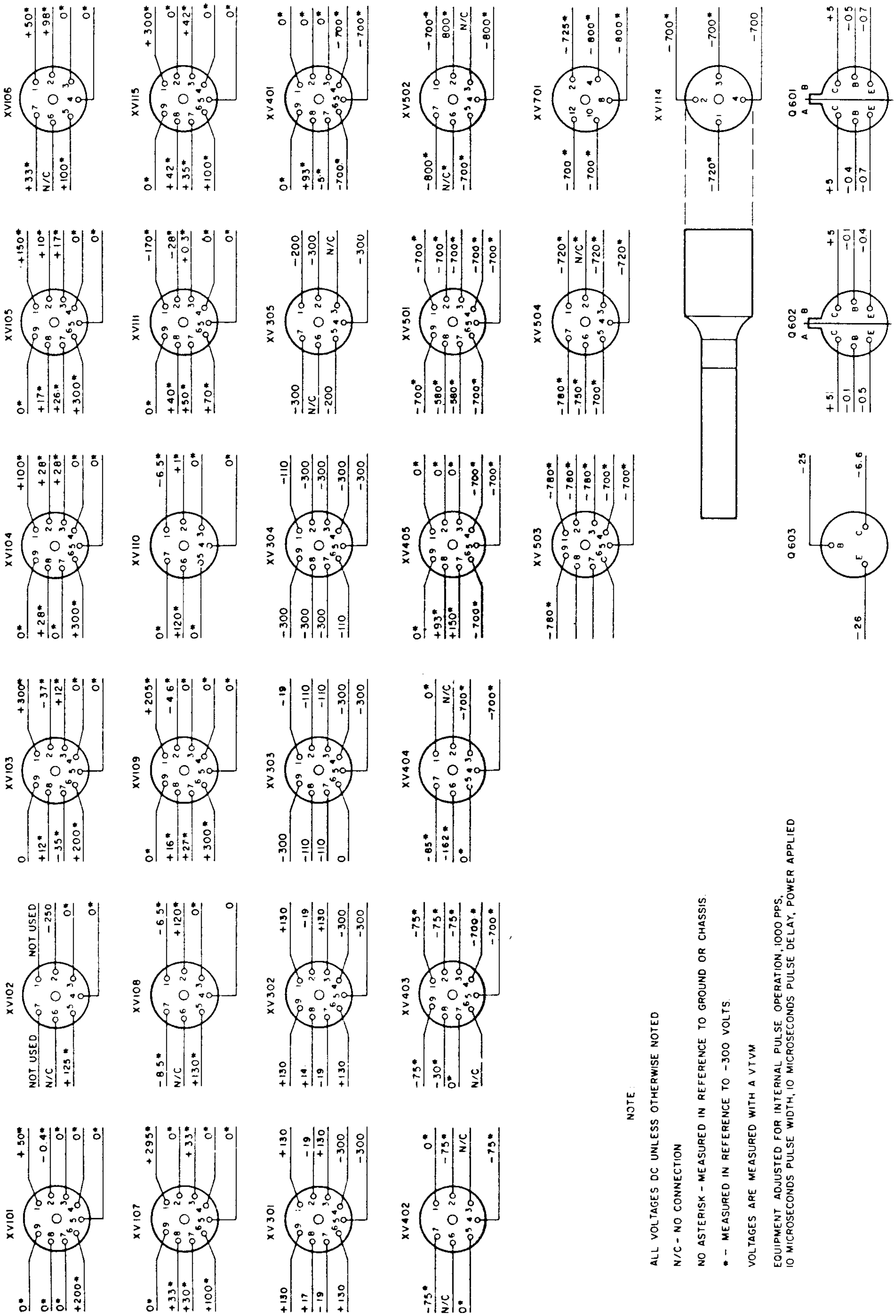
K = 1000 OHMS.

M = MEGOHMS.

MEASUREMENTS MADE WITH VTVM, USING SCALE THAT GIVES READING CLOSEST TO CENTER OF SCALE, REFERENCE TO GROUND, OR CHASSIS.

* THESE VALUES WILL VARY WITH THE SETTINGS OF THE FRONT PANEL CONTROLS.

Figure 5-21. Resistance Chart



NOTE:

ALL VOLTAGES DC UNLESS OTHERWISE NOTED

N/C - NO CONNECTION

NO ASTERISK - MEASURED IN REFERENCE TO GROUND OR CHASSIS.

* - MEASURED IN REFERENCE TO -300 VOLTS.

VOLTAGES ARE MEASURED WITH A VTVM

EQUIPMENT ADJUSTED FOR INTERNAL PULSE OPERATION, 1000 PPS, 10 MICROSECONDS PULSE WIDTH, 10 MICROSECONDS PULSE DELAY, POWER APPLIED

Figure 5-22. Voltage Chart

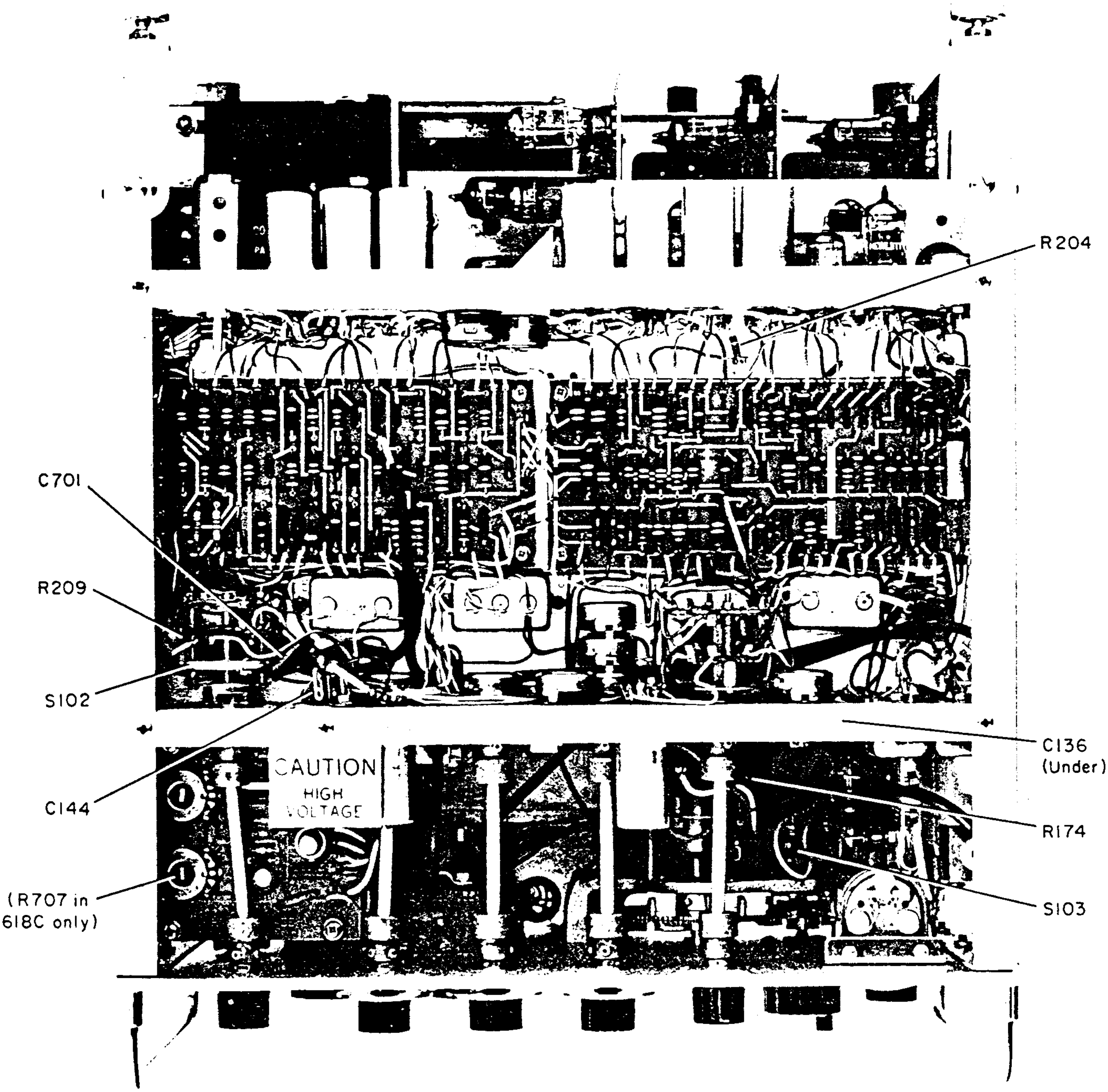


Figure 5-23. Interior View Showing Locations of Unlabeled Chassis Components (Top View)

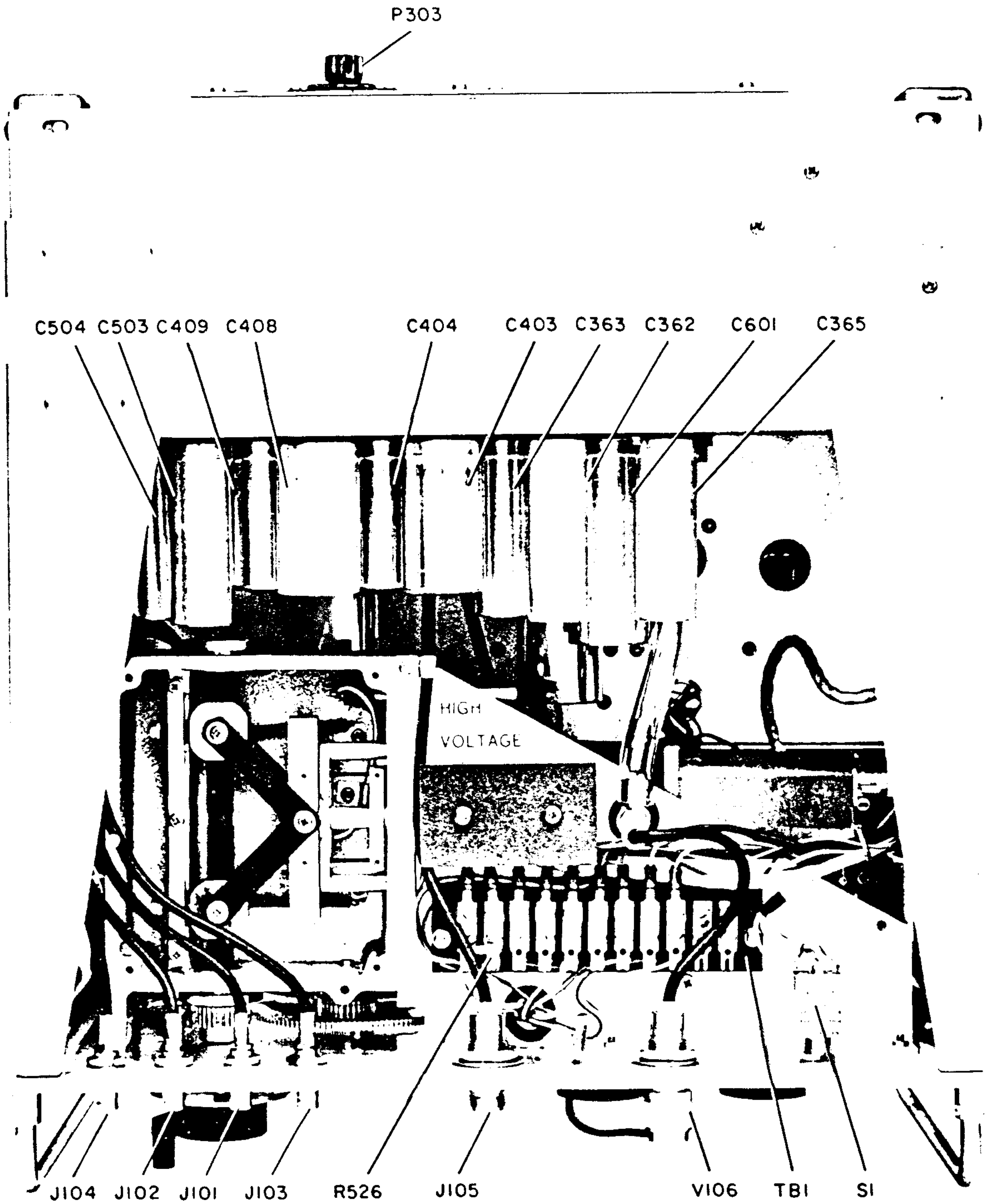


Figure 5-24. Component Identification, Bottom Interior View

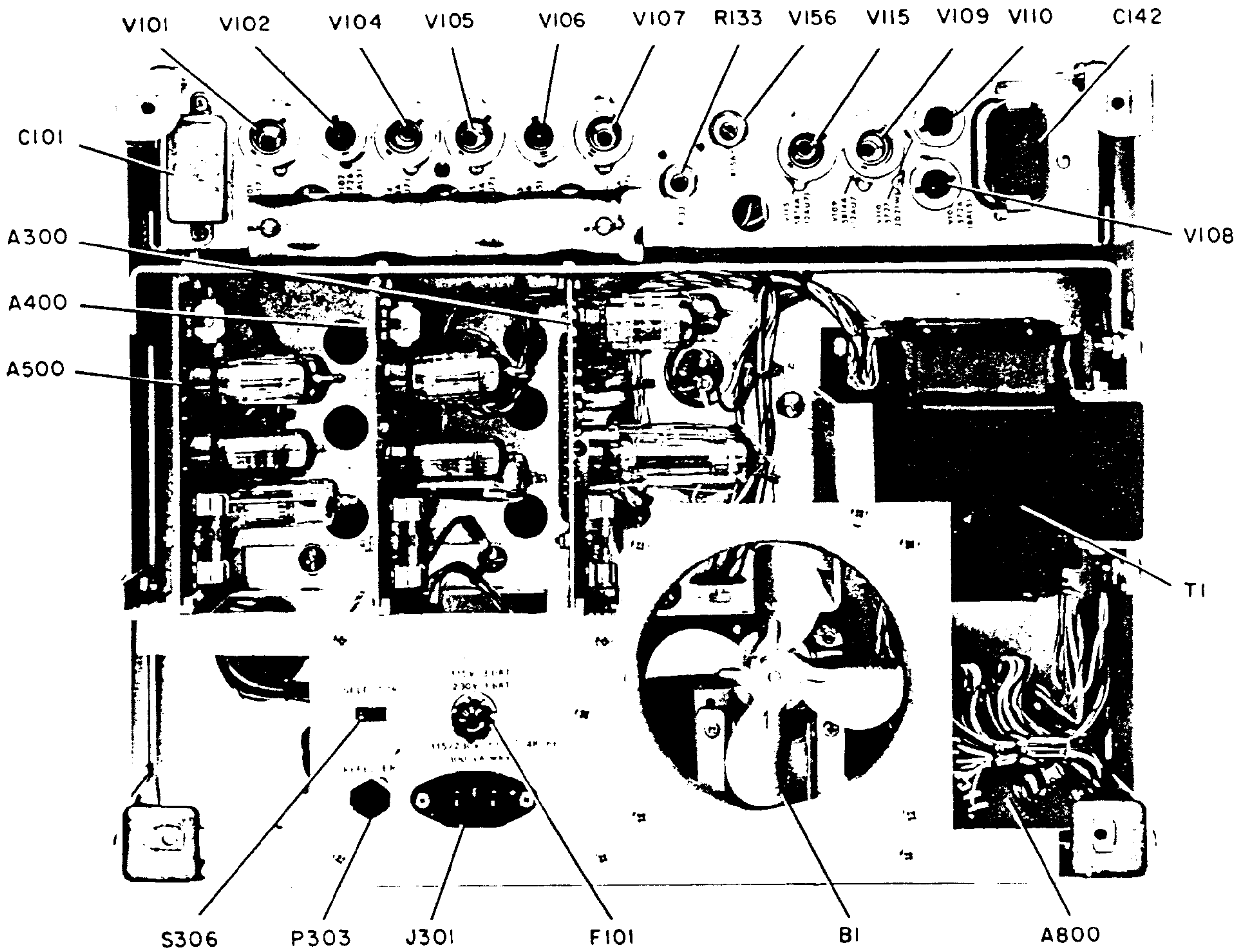
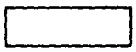


Figure 5-25. Component Identification, Rear Interior View

1. Resistance in ohms, capacitance in microforads unless otherwise noted

2.  screwdriver adjust

3.  front panel designation

4.  test point

5.  voltage regulator (breakdown) diode

6. (947) Encloses wire color code. Code used (MIL-STD-681) is the same as the resistor color code. First number identifies the base color, second number the wider stripe, and the third number identifies the narrower stripe. E.G., 947 denotes white base, yellow wide stripe, violet narrow stripe.

7. Waveform taken with Oscilloscope adjusted for ac coupling

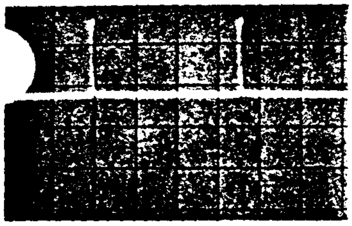
8. Except for test point 23, all waveforms taken with front panel controls set as follows:

   MOD SELECTOR - INT
   PULSE WIDTH - 10
   PULSE DELAY - 0
   PULSE RATE - 200
   FM AMPLITUDE - Fully cw

9. Waveform taken at test point 23 taken with front panel controls set as listed in note 7 except MOD SELECTOR is set to INT FM.

10. Voltages shown on schematic diagrams are with respect to chassis ground.

Figure 5-26. Notes Pertaining to Waveform and Schematic Diagrams



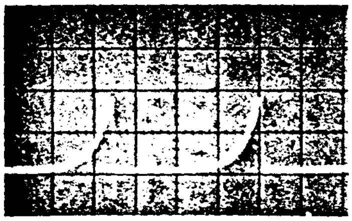
Test Point 14 (Notes 7 and 8)

0.2 MS/CM
0.2 V/CM



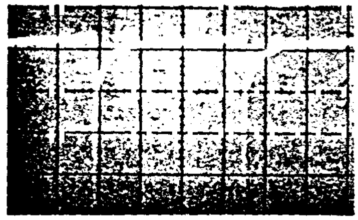
Test Point 15 (Notes 7 and 8)

0.2 MS/CM
2 V/CM



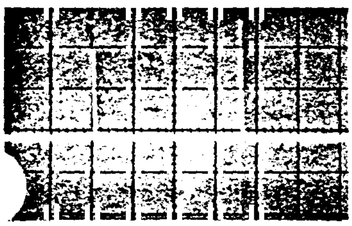
Test Point 16 (Notes 7 and 8)

0.2 MS/CM
0.05 V/CM



Test Point 17 (Notes 7 and 8)

0.2 MS/CM
0.5 V/CM



Test Point 18 (Notes 7 and 8)

0.2 MS/CM
2 V/CM



Test Point 19 (Notes 7 and 8)

0.2 MS/CM
0.2 V/CM



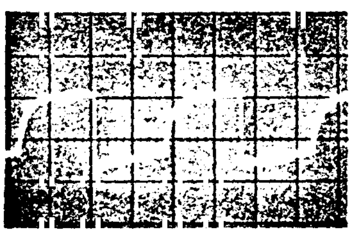
Test Point 20 (Notes 7 and 8)

0.2 MS/CM
0.5 V/CM



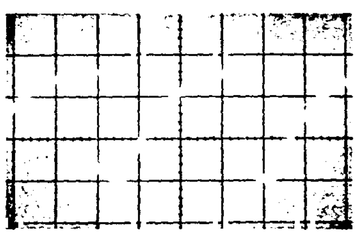
Test Point 21 (Notes 7 and 8)

0.2 MS/CM
0.1 V/CM



Test Point 22 (Notes 7 and 8)

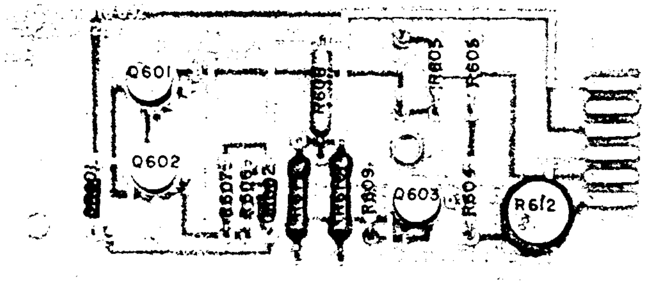
0.2 MS/CM
5 V/CM



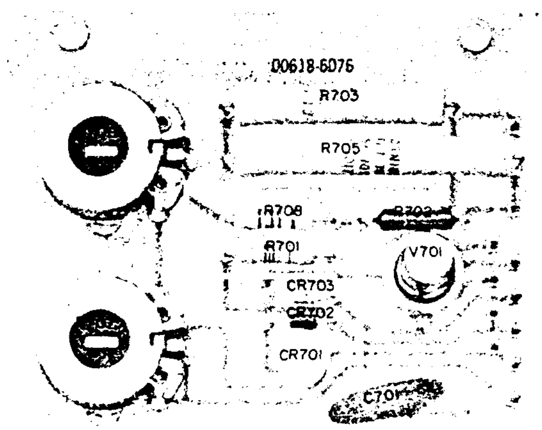
Test Point 24 (Notes 7 and 9)

0.2 MS/CM
5 V/CM

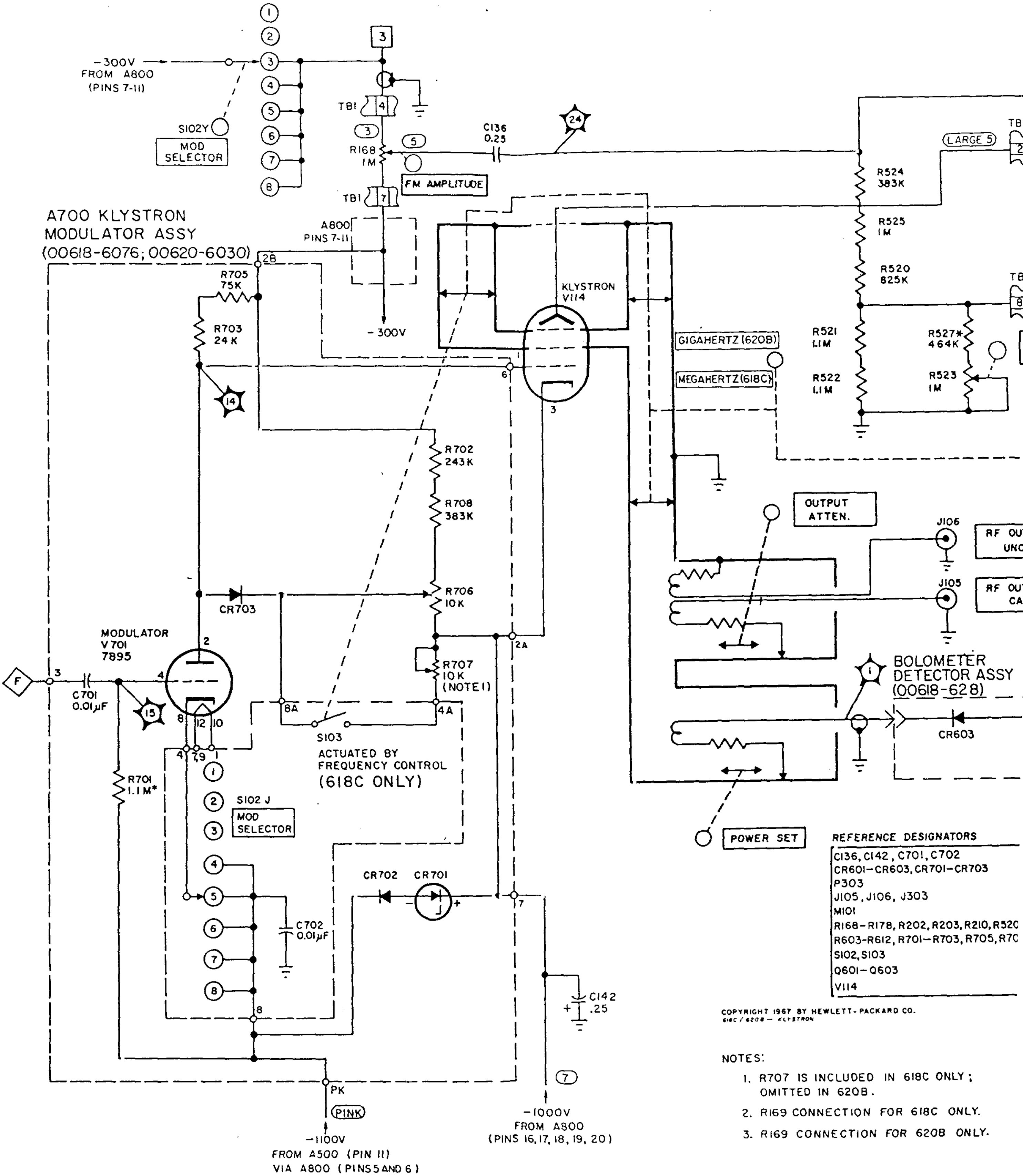
Figure 5-27. Waveforms



Component Identification, A600



Component Identification, A700

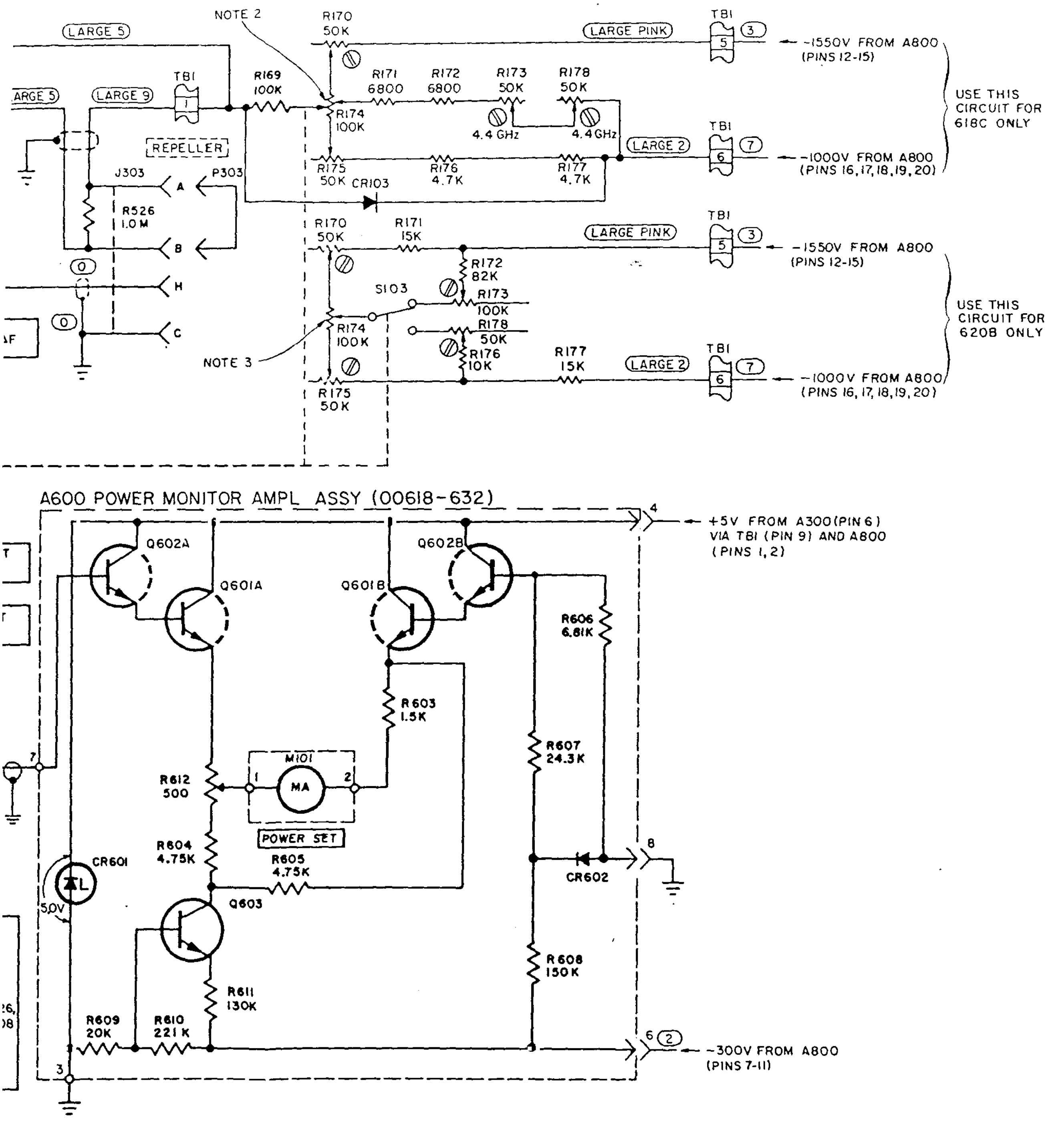


REFERENCE DESIGNATORS

C136, C142, C701, C702
CR601–CR603, CR701–CR703
P303
J105, J106, J303
M101
R168–R178, R202, R203, R210, R52C
R603–R612, R701–R703, R705, R7C
S102, S103
Q601–Q603
V114

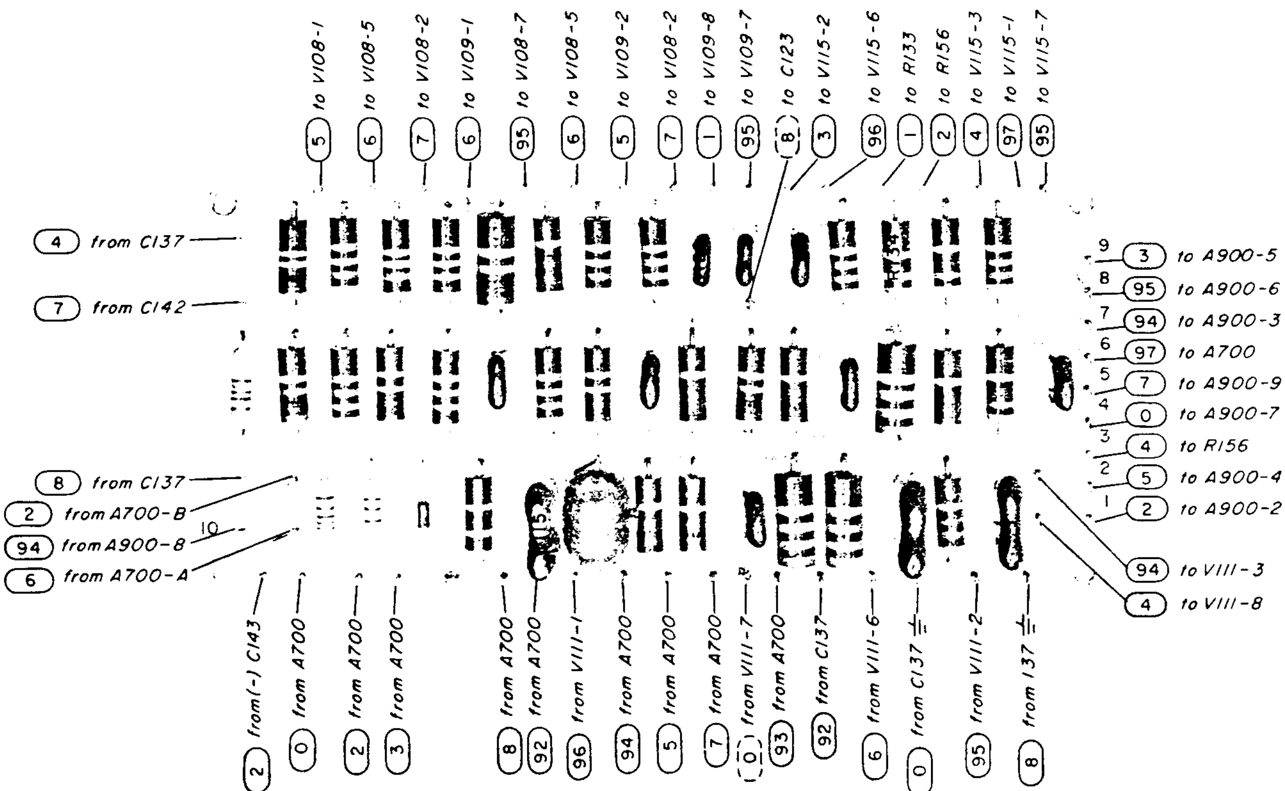
NOTES:

1. R707 IS INCLUDED IN 618C ONLY; OMITTED IN 620B.
2. R169 CONNECTION FOR 618C ONLY.
3. R169 CONNECTION FOR 620B ONLY.

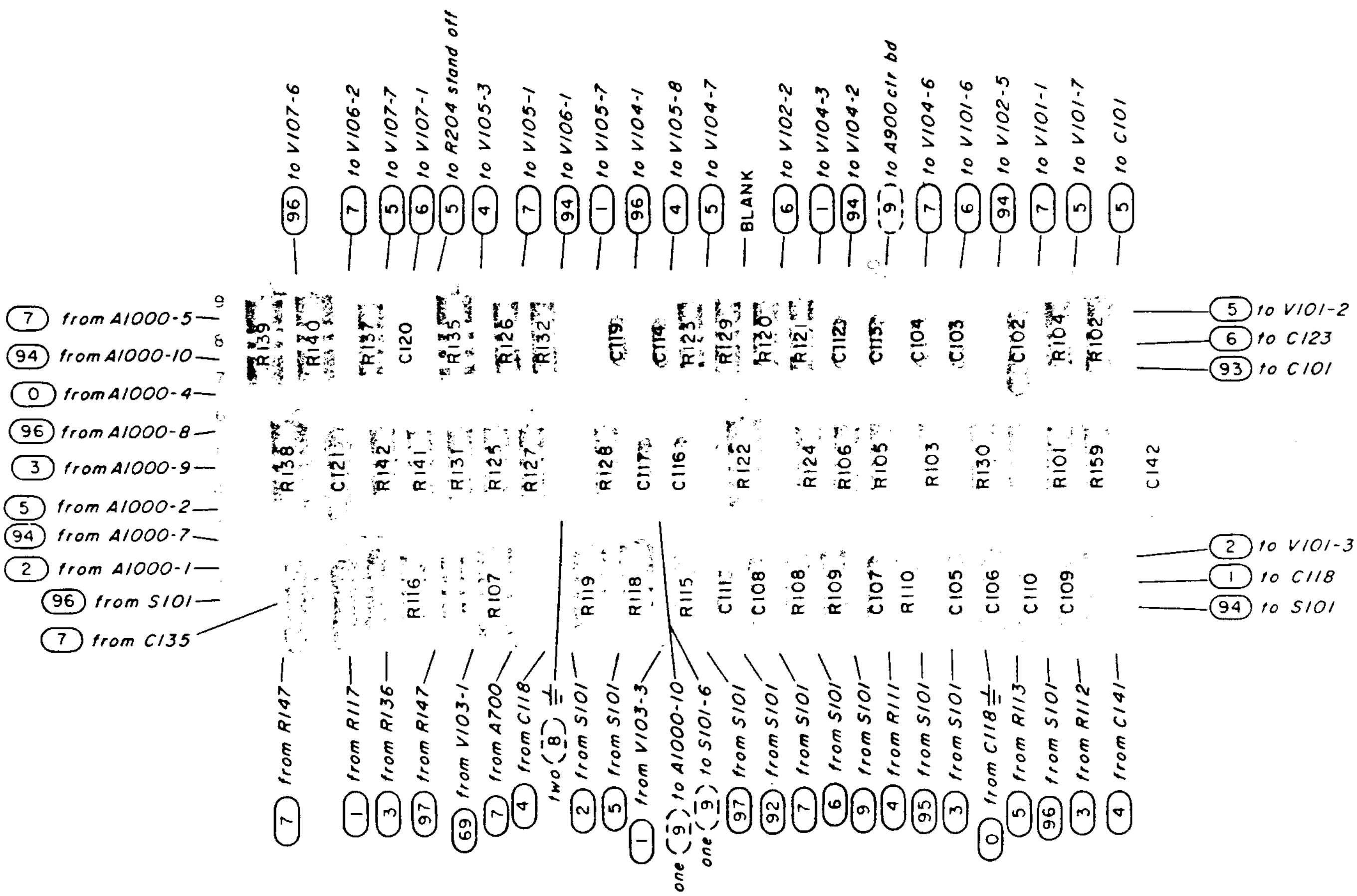


*FACTORY-SELECTED PART, TYPICAL VALUE SHOWN.

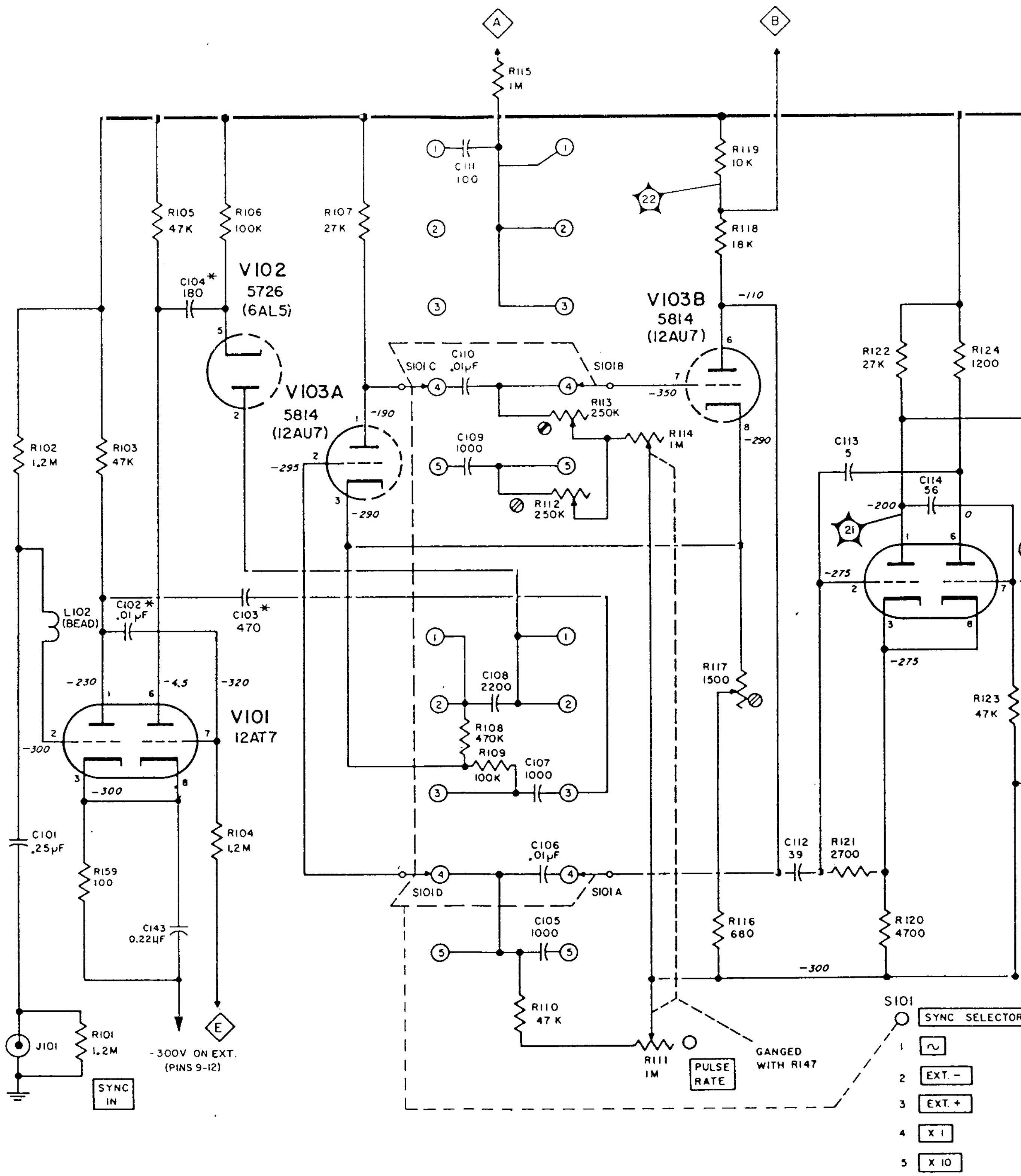
Figure 5-28. Klystron Section

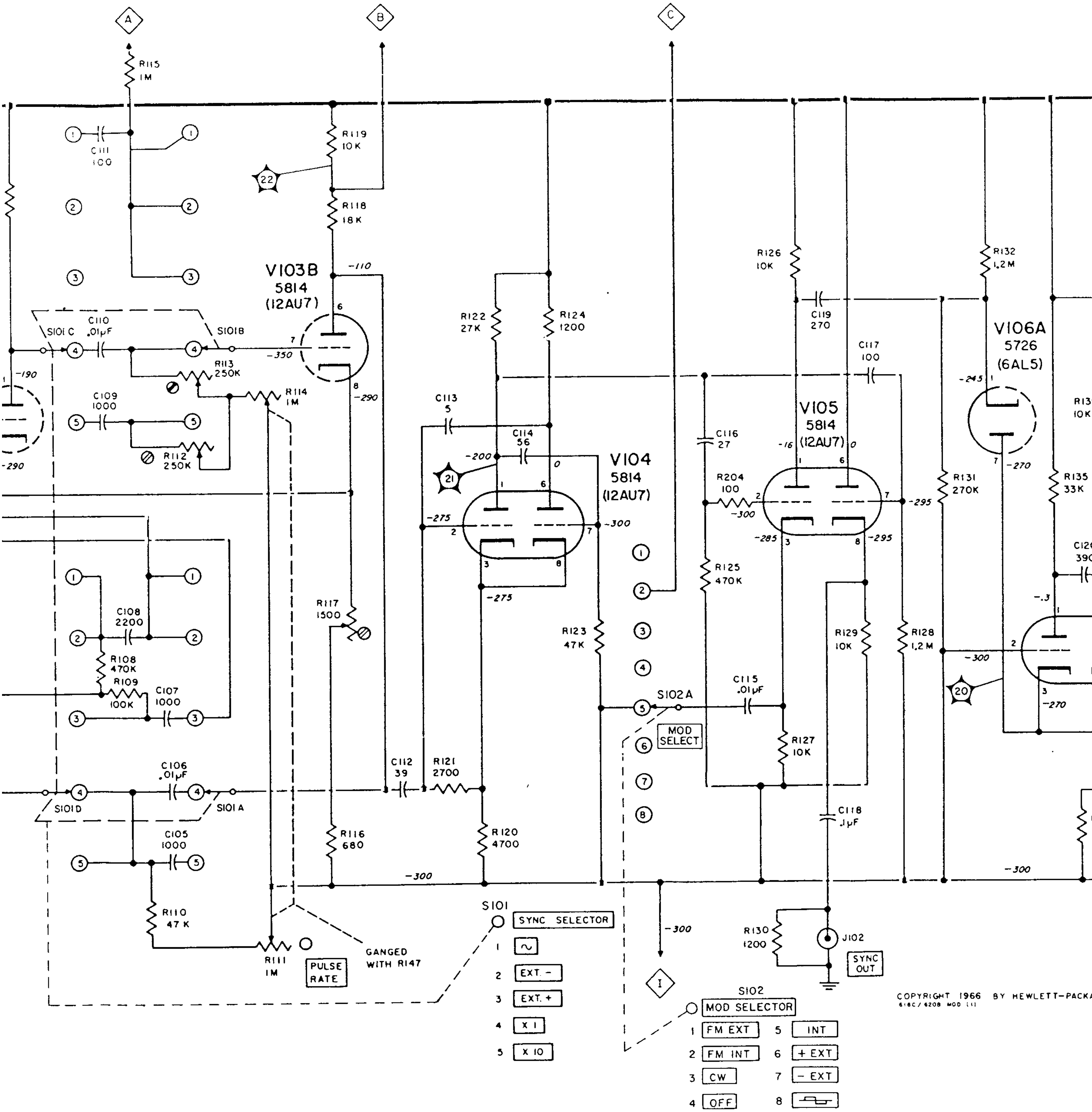


Component Identification, A900



Component Identification, A1000


A
B
R115
1M
C111
100
R119
10K
22
R118
18K
R105
47K
R106
100K
R107
27K
C104*
180
V102
5726
(6AL5)
V103B
5814
(12AU7)
-110
V103A
5814
(12AU7)
S101C
C110
.01µF
S101B
R113
250K
-350
-190
R114
1M
-290
C109
1000
R112
250K
-295
-290
R102
1.2M
R103
47K
C113
5
R122
27K
R124
1200
C114
56
-200
0
21
-275
-275
L102
(BEAD)
C102*
.01µF
C103*
470
-230
-4.5
-320
V101
12AT7
-300
-300
C108
2200
R108
470K
R109
100K
C107
1000
R117
1500
R123
47K
C101
.25µF
R159
100
C143
0.22µF
R104
1.2M
C106
.01µF
S101D
S101A
C112
39
R121
2700
R116
680
R120
4700
C105
1000
-300
R110
47K
J101
R101
1.2M
SYNC
IN
E
-300V ON EXT.
(PINS 9-12)
R111
1M
PULSE
RATE
GANGED
WITH R147
S101
SYNC SELECTOR
1 ∿
2 EXT. -
3 EXT. +
4 X 1
5 X 10


A
B
C
R115 1M
C111 100
R119 10K
R118 18K
V103B 5814 (12AU7)
S101C
C110 .01μF
S101B
R113 250K
R114 1M
C109 1000
R112 250K
C108 2200
R108 470K
R109 100K
C107 1000
R117 1500
C106 .01μF
S101D
S101A
C105 1000
R110 47K
R111 1M
PULSE RATE
GANGED WITH R147
R116 680
C112 39
R121 2700
R120 4700
C113 5
C114 56
R122 27K
R124 1200
V104 5814 (12AU7)
R123 47K
S102A
MOD SELECT
I
S101
SYNC SELECTOR
1 ~
2 EXT. −
3 EXT. +
4 X 1
5 X 10
R126 10K
C119 270
C117 100
C116 27
V105 5814 (12AU7)
R204 100
R125 470K
C115 .01μF
R127 10K
R129 10K
R128 1.2M
C118 .1μF
R130 1200
J102
SYNC OUT
S102
MOD SELECTOR
1 FM EXT
2 FM INT
3 CW
4 OFF
5 INT
6 + EXT
7 − EXT
8
R132 1.2M
V106A 5726 (6AL5)
R131 270K
R135 33K
-110
-350
-290
-190
-200
-275
-300
-16
-285
-295
-245
-270
-.3

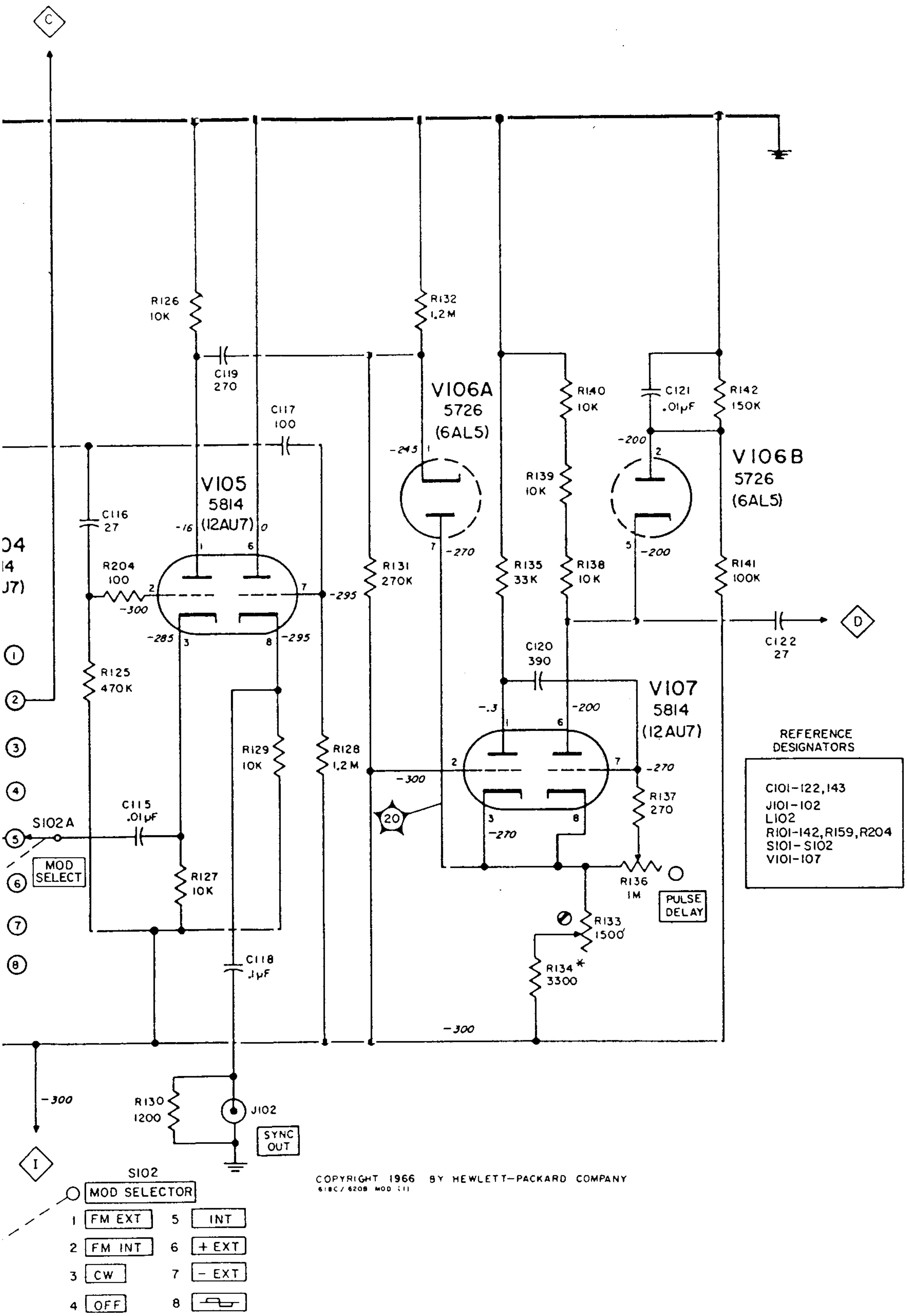
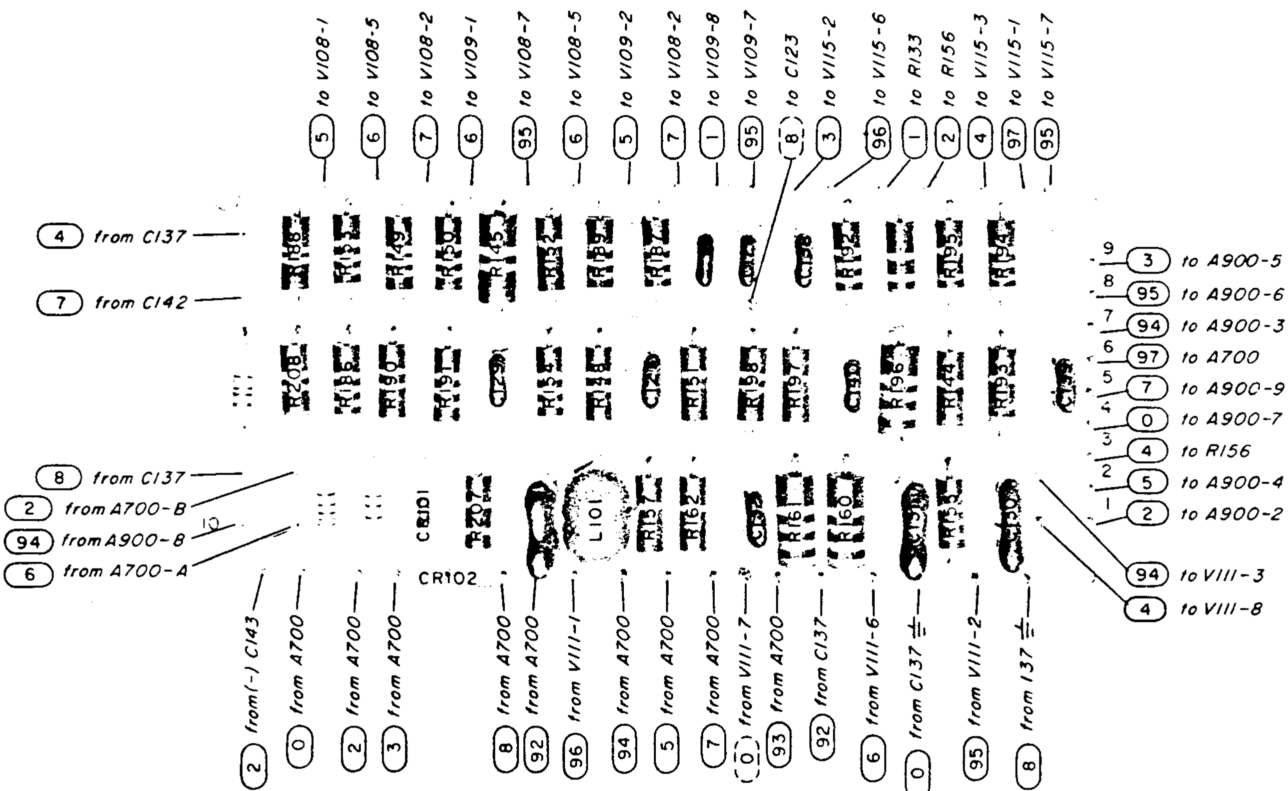
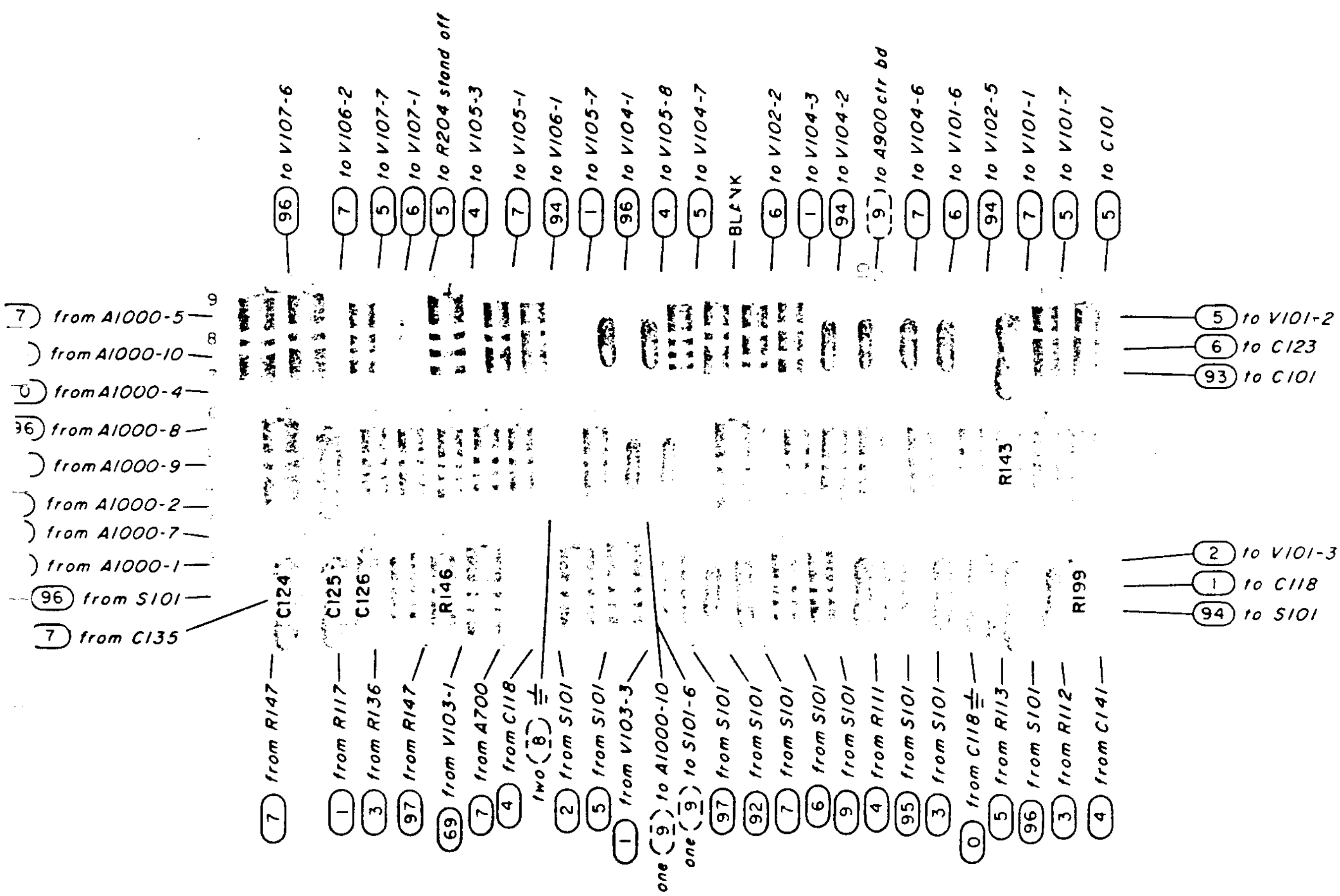


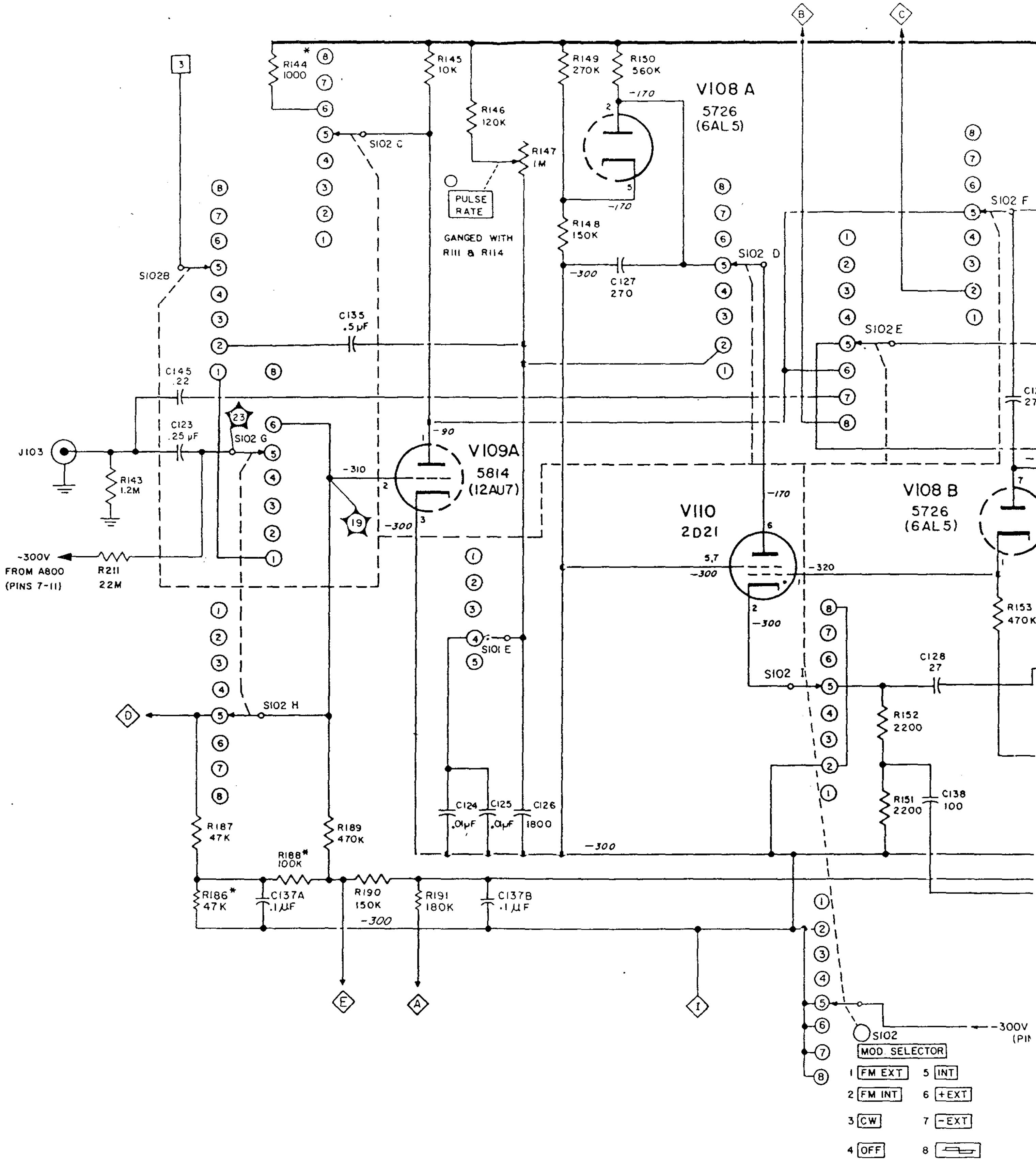
Figure 5-29. Modulator Section (Part 1 of 2)



Component Identification, A900



Component Identification, A1000



V108 A
5726
(6AL5)
V108 B
5726
(6AL5)
V109A
5814
(12AU7)
V110
2D21
J103
R143
1.2M
R144 *
1000
R145
10K
R146
120K
R147
1M
R148
150K
R149
270K
R150
560K
R151
2200
R152
2200
R153
470K
R186 *
47K
R187
47K
R188 *
100K
R189
470K
R190
150K
R191
180K
R211
22M
C123
.25 µF
C124
.01µF
C125
.01µF
C126
1800
C127
270
C128
27
C135
.5 µF
C137A
.1 µF
C137B
.1 µF
C138
100
C145
.22
PULSE RATE
GANGED WITH R111 & R114
S102B
S102 C
S102 D
S102 E
S102 F
S102 G
S102 H
S102 I
S101 E
-300V FROM A800 (PINS 7-11)
S102
MOD. SELECTOR
1 FM EXT
2 FM INT
3 CW
4 OFF
5 INT
6 +EXT
7 -EXT
-170
-90
-310
-300
-320

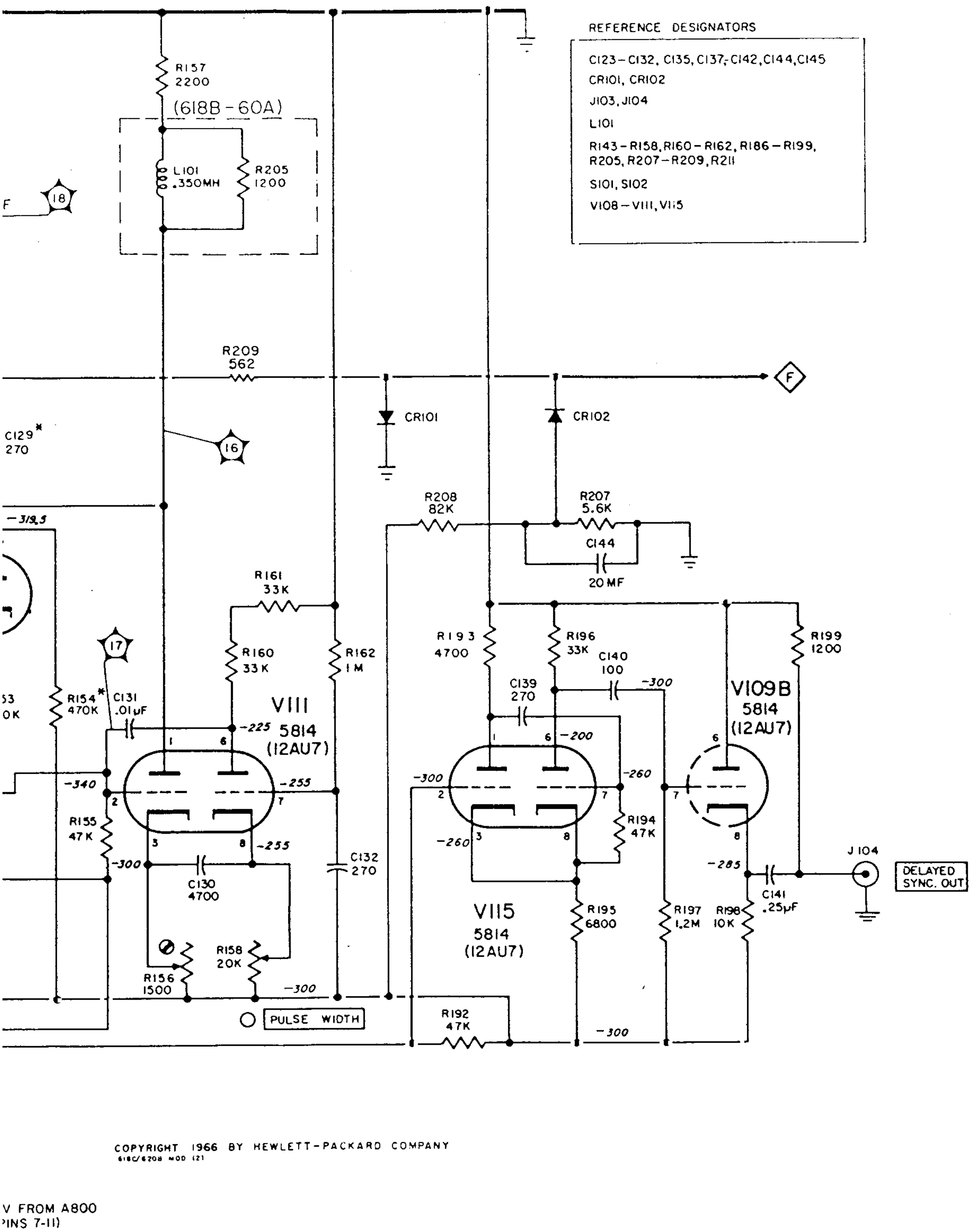
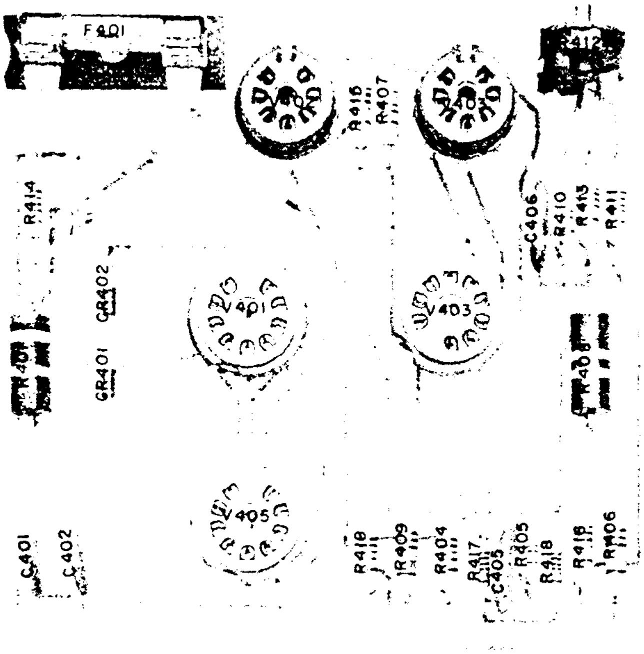
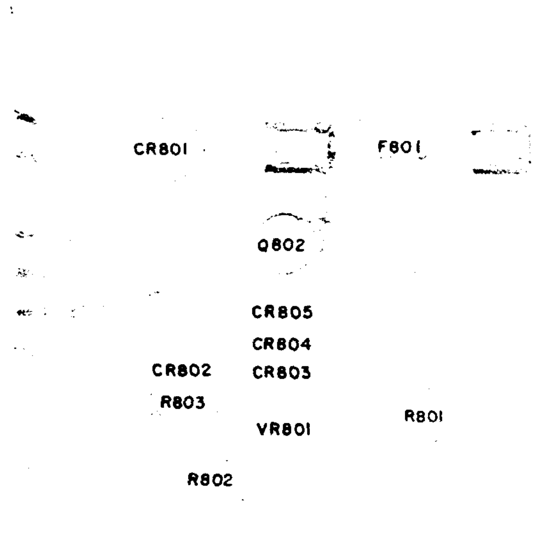


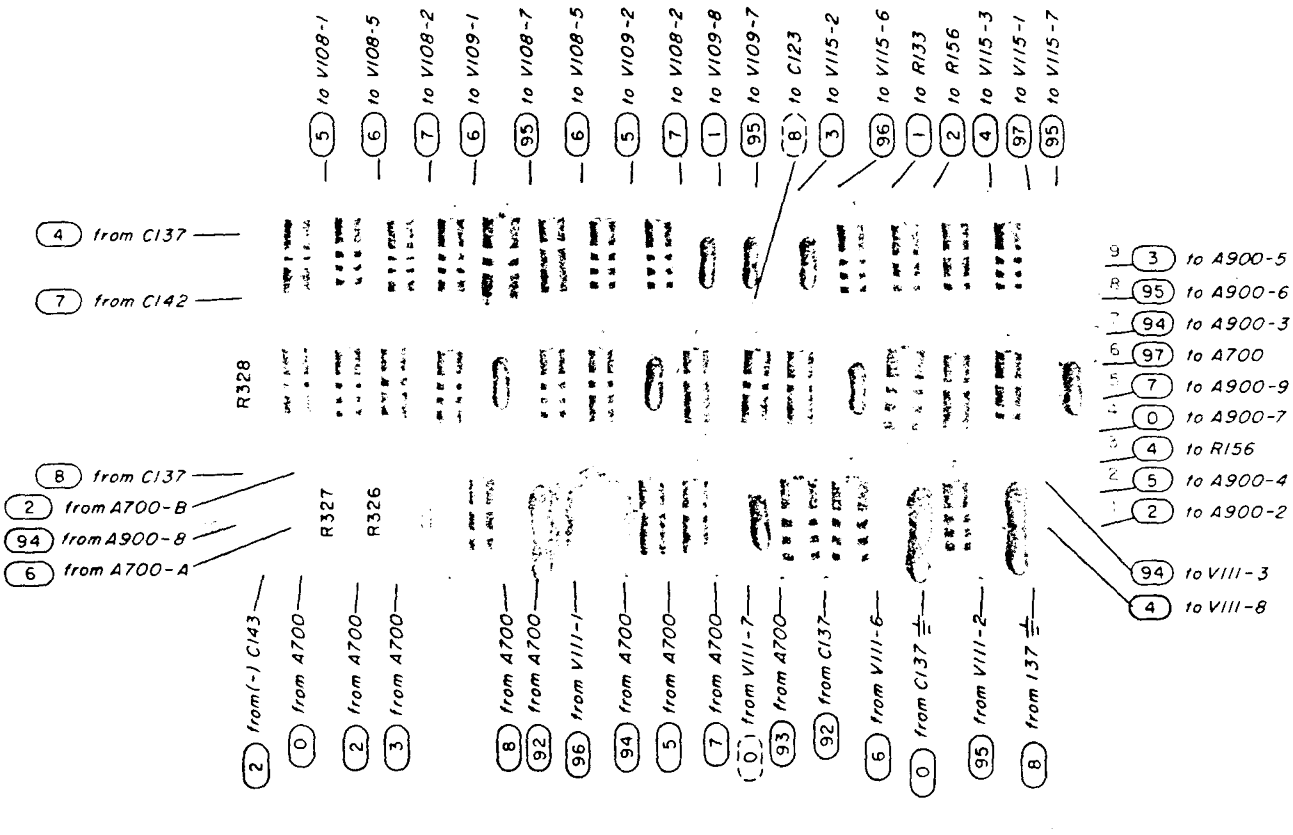
Figure 5-30. Modulator Section (Part 2 of 2)



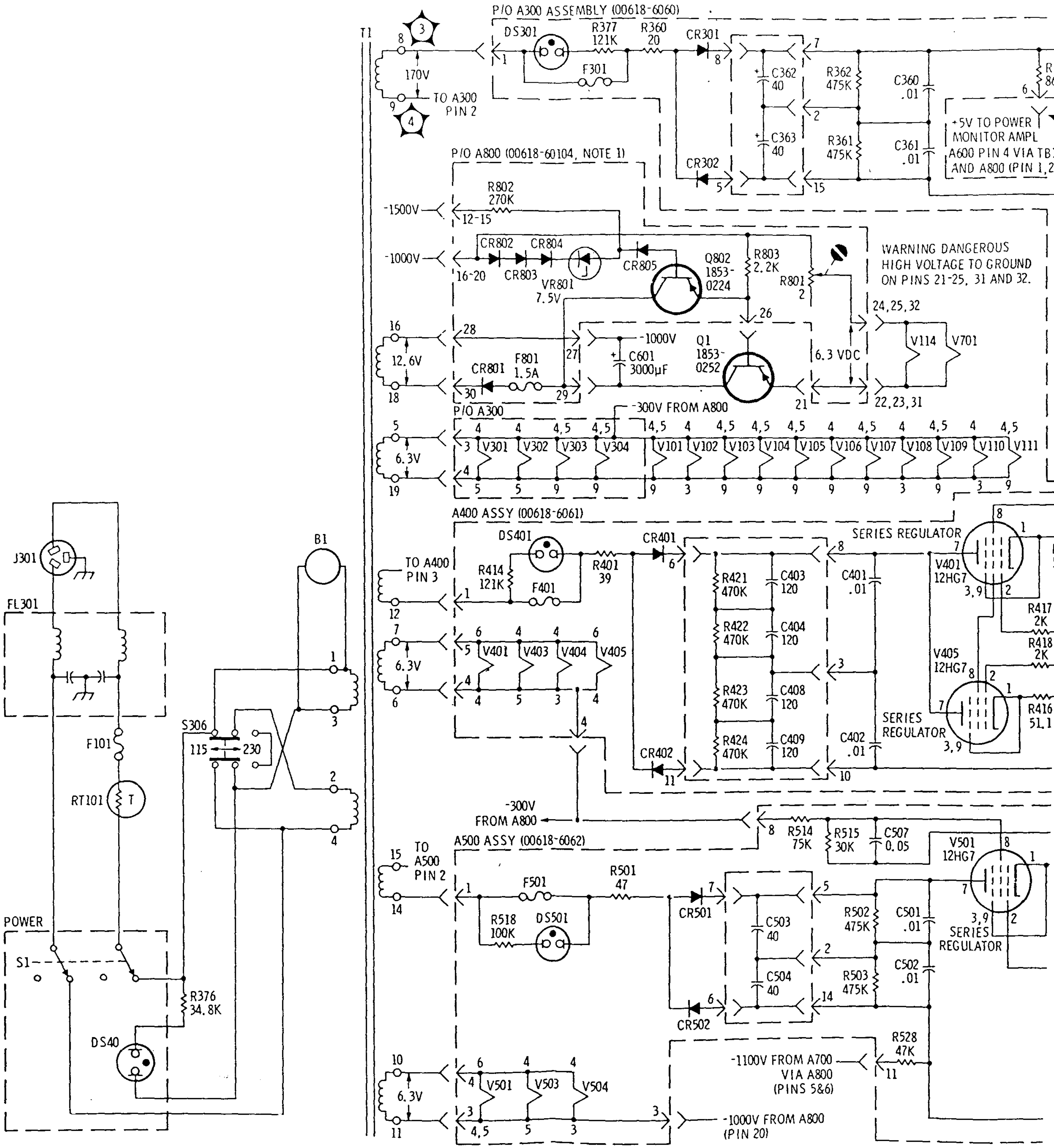
Component Identification, A400



Component Identification, A8



Component Identification, A900



P/O A300 ASSEMBLY (00618-6060)
T1
DS301
R377 121K
R360 20
CR301
F301
C362 40
C363 40
R362 475K
R361 475K
C360 .01
C361 .01
CR302
170V
TO A300 PIN 2
+5V TO POWER MONITOR AMPL A600 PIN 4 VIA TB1 AND A800 (PIN 1,2
P/O A800 (00618-60104, NOTE 1)
-1500V
R802 270K
12-15
-1000V
16-20
CR802
CR803
CR804
VR801 7.5V
CR805
Q802 1853-0224
R803 2.2K
R801
WARNING DANGEROUS HIGH VOLTAGE TO GROUND ON PINS 21-25, 31 AND 32.
24,25,32
V114
V701
22,23,31
12.6V
CR801
F801 1.5A
C601 3000μF
Q1 1853-0252
6.3 VDC
P/O A300
-300V FROM A800
6.3V
V301 V302 V303 V304 V101 V102 V103 V104 V105 V106 V107 V108 V109 V110 V111
A400 ASSY (00618-6061)
DS401
R414 121K
F401
R401 39
CR401
TO A400 PIN 3
R421 470K
R422 470K
R423 470K
R424 470K
C403 120
C404 120
C408 120
C409 120
C401 .01
C402 .01
CR402
SERIES REGULATOR
V401 12HG7
V405 12HG7
R417 2K
R418 2K
R416 51.1
V401 V403 V404 V405
J301
FL301
B1
S306
115
230
F101
RT101
-300V FROM A800
R514 75K
R515 30K
C507 0.05
A500 ASSY (00618-6062)
TO A500 PIN 2
F501
R501 47
R518 100K
DS501
CR501
CR502
C503 40
C504 40
R502 475K
R503 475K
C501 .01
C502 .01
V501 12HG7
SERIES REGULATOR
R528 47K
-1100V FROM A700 VIA A800 (PINS 5&6)
-1000V FROM A800 (PIN 20)
V501 V503 V504
POWER
S1
R376 34.8K
DS40

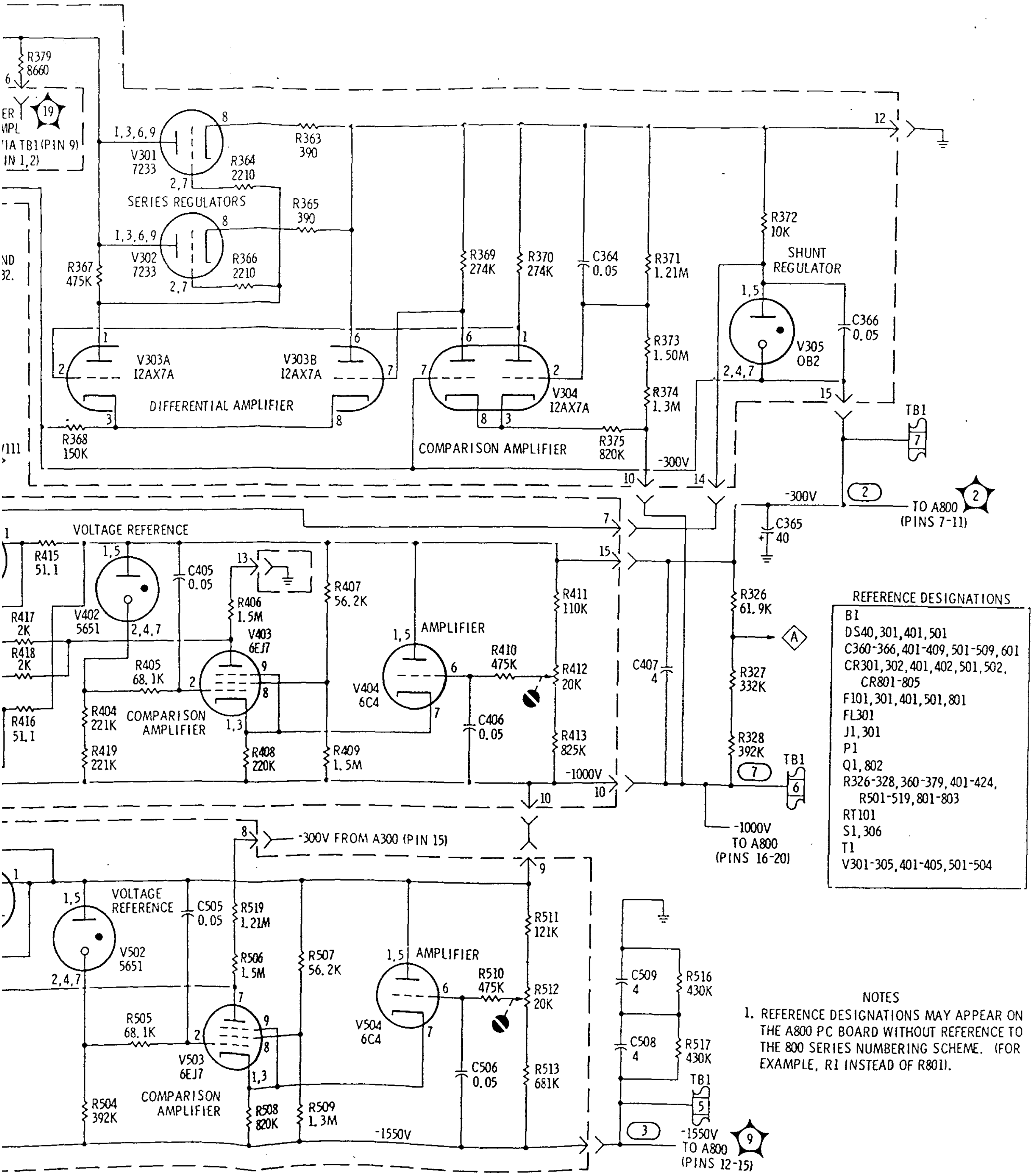
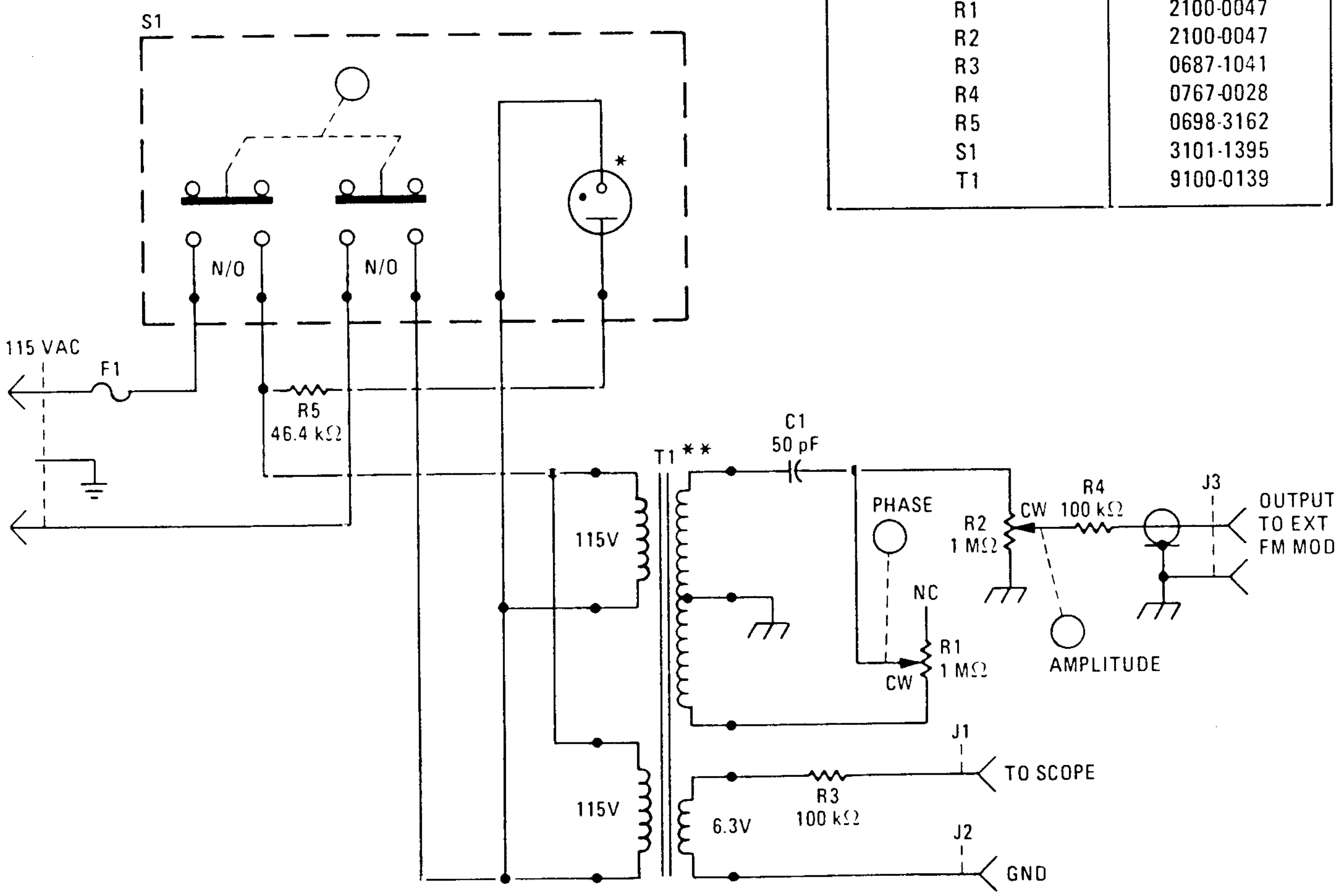


Figure 5-31. Power Supply Section

REFERENCE DESIGNATIONS	HP PART NUMBERS
C1	0160-0904
F1	2100-0201
FUSE HOLDER	1400-0084
J1	1510-0007
J2	1510-0006
J3	1250-0083
R1	2100-0047
R2	2100-0047
R3	0687-1041
R4	0767-0028
R5	0698-3162
S1	3101-1395
T1	9100-0139



* The lamp is part of S1.

** The schematic shows the primary of T1 wired for 115V; it can be wired for 230V.

Figure 5-32. FM Modulator

SECTION VI
REPLACEABLE PARTS

6-1. INFORMATION.

6-2. This section contains information for ordering replaceable parts. Table 6-1 gives the meanings of abbreviations and reference designations used in the table of replaceable parts. Table 6-2 is the table of replaceable parts and is organized as follows:

a. Electrical assemblies and their component parts in alpha-numerical order by reference designation.

b. Chassis-mounted parts in alpha-numerical order by reference designation.

c. Miscellaneous parts.

6-3. The information given for each part consists of:

a. The Hewlett-Packard part number.

b. Total quantity in the instrument.

c. Description of the part.

d. Typical manufacturer of the part in a 5-digit code.

e. The manufacturer's number for the part.

Total quantity for each part is given only once - at the first appearance of the part number.

6-4. Table 6-3 contains the names and addresses that correspond to the manufacturer's code numbers.

6-3. ORDERING INFORMATION.

6-6. To order a replacement part, address order or inquiry to your local Hewlett-Packard sales and service office (see lists at rear of this manual).

6-7. Specify the following information for each part:

a. Model and complete serial number of instrument.

b. Hewlett-Packard part number.

c. Circuit reference designation.

d. Complete description of part.

Table 6-1. Reference Designations and Abbreviations

REFERENCE DESIGNATORS

A	= assembly
B	= motor
BT	= battery
C	= capacitor
CP	= coupler
CR	= diode
DL	= delay line
DS	= device signaling (lamp)
E	= misc electronic part
F	= fuse
FL	= Filter
J	= jack
K	= relay
L	= inductor
LS	= loud speaker
M	= meter
MK	= microphone
MP	= mechanical part
P	= plug
Q	= transistor
R	= resistor
RT	= thermistor
S	= switch
T	= transformer
TB	= terminal board
TP	= test point
U	= integrated circuit
V	= vacuum tube, neon bulb, photocell, etc.
VR	= voltage regulator
W	= cable
X	= socket
Y	= crystal
Z	= tuned cavity, network

ABBREVIATIONS

A	= amperes
AFC	= automatic frequency control
AMPL	= amplifier
BFO	= beat frequency oscillator
BE CU	= beryllium copper
BH	= binder head
BP	= bandpass
BRS	= brass
BWO	= backward wave oscillator
CCW	= counterclockwise
CER	= ceramic
CMO	= cabinet mount only
COEF	= coefficient
COM	= common
COMP	= composition
COMPL	= complete
CONN	= connector
CP	= cadmium plate
CRT	= cathode-ray tube
CW	= clockwise
DEPC	= deposited carbon
DR	= drive
LECT	= electrolytic
NCAP	= encapsulated
EXT	= external
F	= farads
FH	= flat head
FIL H	= Fillister head
FXD	= fixed
G	= giga (10^9)
GE	= germanium
GL	= glass
GRD	= ground(ed)
H	= henries
HDW	= hardware
HEX	= hexagonal
HG	= mercury
HR	= hour(s)
Hz	= Hertz
IF	= intermediate freq
IMPG	= impregnated
INCD	= incandescent
INCL	= include(s)
INS	= insulation(ed)
INT	= internal
K	= kilo = 1000
LH	= left hand
LIN	= linear taper
LK WASH	= lock washer
LOG	= logarithmic taper
LPF	= low pass filter
M	= milli = 10^{-3}
MEG	= meg = 10^6
MET FLM	= metal film
MET OX	= metallic oxide
MFR	= manufacturer
MHz	= mega Hertz
MINAT	= miniature
MOM	= momentary
MOS	= metalized substrate
MTG	= mounting
MY	= "mylar"
N	= nano (10^{-9})
N/C	= normally closed
NE	= neon
NI PL	= nickel plate
N/O	= normally open
NOM	= nominal
NPO	= negative positive zero (zero temperature coefficient)
NPN	= negative-positive-negative
NRFR	= not recommended for field replacement
NSR	= not separately replaceable
OBD	= order by description
OH	= oval head
OX	= oxide
P	= peak
PC	= printed circuit
PF	= picofarads = 10^{-12} farads
PH BRZ	= phosphor bronze
PHL	= Phillips
PIV	= peak inverse voltage
PNP	= positive-negative-positive
P/O	= part of
POLY	= polystrene
PORC	= porcelain
POS	= position(s)
POT	= potentiometer
PP	= peak-to-peak
PT	= point
PWV	= peak working voltage
RECT	= rectifier
RF	= radio frequency
RH	= round head or right hand
RMO	= rack mount only
RMS	= root-mean square
RWV	= reverse working voltage
S-B	= slow-blow
SCR	= screw
SE	= selenium
SECT	= section(s)
SEMICON	= semiconductor
SI	= silicon
SIL	= silver
SL	= slide
SPG	= spring
SPL	= special
SST	= Stainless steel
SR	= split ring
STL	= steel
TA	= tantalum
TD	= time delay
TGL	= toggle
THD	= thread
TI	= titanium
TOL	= tolerance
TRIM	= trimmer
TWT	= traveling wave tube
μ	= micro = 10^{-6}
VAR	= variable
VDCW	= dc working volts
W/	= with
W	= watts
WIV	= working inverse voltage
WW	= wirewound
W/O	= without

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A300	00618-6060	1	BOARD ASSEMBLY,-300 VPS	28480	00618-6060
C360	0150-0012	6	CAPACITOR-FXD ,01UF +-20% 1KVDC CER	0420J	C023A102J103M838
C361	0150-0012		CAPACITOR-FXD ,01UF +-20% 1KVDC CER	0420J	C023A102J103M838
C366	0150-0052	4	CAPACITOR-FXD ,05UF +-20% 400VDC CER	28480	0150-0052
CR301	1901-0029	3	DIODE-PWR RECT 600V 750MA DO-29	0271C	MP494
CR302	1901-0029		DIODE-PWR RECT 600V 750MA DO-29	0271C	MP494
DS301	2140-0047	3	LAMP-GLOW A1C 135/105VDC 800UA T-2-BULB	74276	A1C
F301	2110-0008	2	FUSE ,5A 125V SLO-BLO 1,25X,25 UL	0470C	313,500
	1400-0008	3	FUSEHOLDER-BLOCK 15A 250V 1-FU	28480	1400-0008
R360	0813-0040	1	RESISTOR 20 5% 5W PW TC=0+-20	0552D	RS-5
R361	0757-0789	5	RESISTOR 475K 1% ,25W F TC=0+-100	03418	C5-1/4-T0-4753-F
R362	0757-0789		RESISTOR 475K 1% ,25W F TC=0+-100	03418	C5-1/4-T0-4753-F
R363	0690-3911	2	RESISTOR 390 10% 1W CC TC=0+529	01606	GB3911
R364	0757-0746	2	RESISTOR 2,21K 1% ,25W F TC=0+-100	03418	C5-1/4-T0-2211-F
R365	0690-3911		RESISTOR 390 10% 1W CC TC=0+529	01606	GB3911
R366	0757-0746		RESISTOR 2,21K 1% ,25W F TC=0+-100	03418	C5-1/4-T0-2211-F
R367	0757-0789		RESISTOR 475K 1% ,25W F TC=0+-100	03418	C5-1/4-T0-4753-F
R368	0757-0352	2	RESISTOR 150K 1% ,5W F TC=0+-100	0299E	MF7C1/2-T0-1503-F
R369	0757-0131	2	RESISTOR 274K 1% ,5W F TC=0+-100	0299E	MF7C1/2-T0-2743-F
R370	0757-0131		RESISTOR 274K 1% ,5W F TC=0+-100	0299E	MF7C1/2-T0-2743-F
R371	0757-0871	2	RESISTOR 1,21M 1% ,5W F TC=0+-100	0299E	MF7C1/2-T0-1214-F
R372	0811-0007	1	RESISTOR 10K 1% 5W PW TC=0+-20	0552D	RS-5
R373	0757-0156	4	RESISTOR 1,5M 1% ,5W F TC=0+-100	0299E	MF7C1/2-T0-1504-F
R374	0757-0872	2	RESISTOR 1,3M 1% ,5W F TC=0+-100	0299E	MF7C1/2-T0-1304-F
R375	0690-8241	1	RESISTOR 820K 10% 1W CC TC=0+882	01606	GB8241
R377	0757-0777	3	RESISTOR 121K 1% ,25W F TC=0+-100	03418	C5-1/4-T0-1213-F
R379	0812-0038	1	RESISTOR 8,66K 3% 5W PW TC=0+-20	0552D	RS-5
V301	1921-0014	2	TUBE-ELECTRON 7233 TRIODE	33173	7233
V302	1921-0014		TUBE-ELECTRON 7233 TRIODE	33173	7233
V303	1932-0030	2	TUBE-ELECTRON 12AX7A TRIODE-DUAL	33173	12AX7A
V304	1932-0030		TUBE-ELECTRON 12AX7A TRIODE-DUAL	33173	12AX7A
V305	1940-0007	1	TUBE-ELECTRON 0B2 DIODE-V RGLTR	0599A	0B2
A400	00618-6061	1	BOARD ASSEMBLY,-1000 VPS	28480	00618-6061
C401	0150-0012		CAPACITOR-FXD ,01UF +-20% 1KVDC CER	0420J	C023A102J103M838
C402	0150-0012		CAPACITOR-FXD ,01UF +-20% 1KVDC CER	0420J	C023A102J103M838
C405	0150-0052		CAPACITOR-FXD ,05UF +-20% 400VDC CER	28480	0150-0052
C406	0160-0904	2	CAPACITOR-FXD ,05UF +-20% 1KVDC CER	28480	0160-0904
CR401	1901-0487	2	DIODE-HV RECT 1,5KV 250MA DO-29	02036	BR 2016-2
CR402	1901-0487		DIODE-HV RECT 1,5KV 250MA DO-29	0203B	BR 2016-2
DS401	2140-0047		LAMP-GLOW A1C 135/105VDC 800UA T-2-BULB	74276	A1C
F401	2110-0008		FUSE ,5A 125V SLO-BLO 1,25X,25 UL	0470C	313,500
	1400-0008		FUSEHOLDER-BLOCK 15A 250V 1-FU	28480	1400-0008
R401	0693-3901	1	RESISTOR 39 10% 2W CC TC=0+412	01606	HB3901
R404	0757-0862	3	RESISTOR 221K 1% ,5W F TC=0+-100	0299E	MF7C1/2-T0-2213-F
R405	0757-0772	2	RESISTOR 68,1K 1% ,25W F TC=0+-100	03418	C5-1/4-T0-6812-F
R406	0757-0156		RESISTOR 1,5M 1% ,5W F TC=0+-100	0299E	MF7C1/2-T0-1504-F
R407	0757-0858	2	RESISTOR 56,2K 1% ,5W F TC=0+-100	0299E	MF7C1/2-T0-5622-F
R408	0693-2241	1	RESISTOR 220K 10% 2W CC TC=0+882	01606	HB2241
R409	0757-0156		RESISTOR 1,5M 1% ,5W F TC=0+-100	0299E	MF7C1/2-T0-1504-F
R410	0757-0789		RESISTOR 475K 1% ,25W F TC=0+-100	03418	C5-1/4-T0-4753-F
R411	0757-0859	1	RESISTOR 110K 1% ,5W F TC=0+-100	0299E	MF7C1/2-T0-1103-F
R412	2100-1762	2	RESISTOR-TRMR 20K 5% WW SIDE-ADJ 1-TRN	03740	3345W-W50-203
R413	0757-0870	2	RESISTOR 825K 1% ,5W F TC=0+-100	0299E	MF7C1/2-T0-8253-F
R414	0757-0777		RESISTOR 121K 1% ,25W F TC=0+-100	03418	C5-1/4-T0-1213-F
R415	0757-1000	2	RESISTOR 51,1 1% ,5W F TC=0+-100	0299E	MF7C1/2-T0-51R1-F
R416	0757-1000		RESISTOR 51,1 1% ,5W F TC=0+-100	0299E	MF7C1/2-T0-51R1-F
R417	0757-0283	2	RESISTOR 2K 1% ,125W F TC=0+-100	0329B	C4-1/8-T0-2001-F
R418	0757-0283		RESISTOR 2K 1% ,125W F TC=0+-100	0329B	C4-1/8-T0-2001-F
R419	0757-0862		RESISTOR 221K 1% ,5W F TC=0+-100	0299E	MF7C1/2-T0-2213-F
V401	1923-0071	3	TUBE-ELECTRON 12HG7 PENTODE	33173	12HG7
V402	1940-0001	2	TUBE-ELECTRON 5651A DIODE-V RGLTR	14830	5651A
V403	1923-0046	2	TUBE-ELECTRON 6EJ7 PENTODE	0457I	6EJ7(EF184)
V404	1921-0005	2	TUBE-ELECTRON 6C4 TRIODE	33173	6C4
V405	1923-0071		TUBE-ELECTRON 12HG7 PENTODE	33173	12HG7

See introduction to this section for ordering information

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A500	00618-6062	1	BOARD ASSEMBLY,-1550 VPS	28480	00618-6062
C501	0150-0012		CAPACITOR-FXD .01UF +-20% 1KVDC CER	0420J	C023A102J103M838
C502	0150-0012		CAPACITOR-FXD .01UF +-20% 1KVDC CER	0420J	C023A102J103M838
C505	0150-0052		CAPACITOR-FXD .05UF +-20% 400VDC CER	28480	0150-0052
C506	0160-0904		CAPACITOR-FXD .05UF +-20% 1KVDC CER	28480	0160-0904
C507	0150-0052		CAPACITOR-FXD .05UF +-20% 400VDC CER	28480	0150-0052
CR501	1901-0036	4	DIODE-HV RECT 1KV 600MA DO-29	0271C	MP496
CR502	1901-0036		DIODE-HV RECT 1KV 600MA DO-29	0271C	MP496
DS501	2140-0047		LAMP-GLOW A1C 135/105VDC 800UA T-2-BULB	74276	A1C
E501	9170-0029	3	CORE-SHIELDING BEAD	0188G	56-590-65A2/4A
E502	9170-0029		CORE-SHIELDING BEAD	0188G	56-590-65A2/4A
F501	2110-0012	1	FUSE .5A 250V FAST-BLO 1.25X.25 UL IEC	0470C	312.500
	1400-0008		FUSEHOLDER-BLOCK 15A 250V 1-FU	28480	1400-0008
R501	0693-4701	1	RESISTOR 47 10% 2W CC TC=0+412	0160G	HB4701
R502	0757-0374	2	RESISTOR 475K 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-4753-F
R503	0757-0374		RESISTOR 475K 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-4753-F
R504	0757-0313	2	RESISTOR 392K 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-3923-F
R505	0757-0772		RESISTOR 68.1K 1% .25W F TC=0+-100	03418	C5-1/4-T0-6812-F
R506	0757-0156		RESISTOR 1.5M 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-1504-F
R507	0757-0854		RESISTOR 56.2K 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-5622-F
R508	0730-0161	1	RESISTOR 820K 1% 1W CF TC=0-500	0552D	DC1-8203-F
R509	0757-0872		RESISTOR 1.3M 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-1304-F
R510	0757-0789		RESISTOR 475K 1% .25W F TC=0+-100	03418	C5-1/4-T0-4753-F
R511	0757-0777		RESISTOR 121K 1% .25W F TC=0+-100	03418	C5-1/4-T0-1213-F
R512	2100-1762		RESISTOR-TRMR 20K 5% WW SIDE-ADJ 1-TRN	0374D	3345W-W50-203
R513	0757-0792	1	RESISTOR 681K 1% .25W F TC=0+-100	03418	C5-1/4-T0-6813-F
R514	0777-0002	2	RESISTOR 75K 10% 7W MO TC=0+-250	03418	FP7-7-250-7502-K
R515	0771-0007	1	RESISTOR 30K 10% 4W MO TC=0+-250	03418	FP4-4-250-3002-K
R518	0757-0367	1	RESISTOR 100K 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-1003-F
R519	0757-0871		RESISTOR 1.21M 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-1214-F
R528	0698-6303	1	RESISTOR 47K 10% 7W MO TC=0+-250	03418	FP7-7-250-4702-K
V501	1923-0071		TUBE-ELECTRON 12HG7 PENTODE	33173	12HG7
V502	1940-0001		TUBE-ELECTRON 5651A DIODE-V RGLTR	14830	5651A
V503	1923-0046		TUBE-ELECTRON 6EJ7 PENTODE	0457I	6EJ7(EF184)
V504	1921-0005		TUBE-ELECTRON 6C4 TRIODE	33173	6C4
A600	00618-632	1	BOARD ASSEMBLY, POWER MONITOR AMPLIFIER	28480	00618-632
CR601	1902-0041	1	DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.009%	02038	BZ 10939-98
CR602	1901-0025	1	DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
Q601	1854-0221	2	TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0221
Q602	1854-0221		TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0221
Q603	1854-0003	1	TRANSISTOR NPN SI TO-39 PD=800MW	28480	1854-0003
R603	0757-0427	1	RESISTOR 1.5K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1501-F
R604	0757-0437	2	RESISTOR 4.75K 1% .125W F TC=0+-100	03298	C4-1/8-T0-4751-F
R605	0757-0437		RESISTOR 4.75K 1% .125W F TC=0+-100	03298	C4-1/8-T0-4751-F
R606	0757-0439	1	RESISTOR 6.81K 1% .125W F TC=0+-100	03298	C4-1/8-T0-6811-F
R607	0757-0451	1	RESISTOR 24.3K 1% .125W F TC=0+-100	03298	C4-1/8-T0-2432-F
R608	0757-0352		RESISTOR 150K 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-1503-F
R609	0757-0449	1	RESISTOR 20K 1% .125W F TC=0+-100	03298	C4-1/8-T0-2002-F
R610	0757-0862		RESISTOR 221K 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-2213-F
R611	0757-0861	1	RESISTOR 130K 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-1303-F
R612	2100-1772	1	RESISTOR-TRMR 500 5% WW TOP-ADJ 1-TRN	0374D	3345P-W50-501
A700	00618-6076	2	BOARD ASSEMBLY,KLYSTRON MODULATOR(618C)	28480	00618-6076
A700	00618-6076		BOARD ASSEMBLY,KLYSTRON MODULATOR(620B)	28480	00618-6076
C701	0160-0265	2	CAPACITOR-FXD .01UF +-20% 3KVDC CER	28480	0160-0265
CR701	1902-0281	1	DIODE-ZNR 100V 5% PD=1.5W TC=+.094%	02036	SZ1521-344
CR702	1901-0026	1	DIODE-PWR RECT 200V 750MA DO-29	0271C	MP492
CR703	1901-0519	1	DIODE-SWITCHING 200V 50NS DO-34	28480	1901-0519
R701	0757-0139	3	RESISTOR 1.1M 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-1104-F
R702	0757-0863	1	RESISTOR 243K 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-2433-F
R703	0771-0005	1	RESISTOR 24K 10% 4W MO TC=0+-250	03418	FP4-4-250-2402-K
R705	0777-0002		RESISTOR 75K 10% 7W MO TC=0+-250	03418	FP7-7-250-7502-K
R706	2100-2154	2	RESISTOR-TRMR 10K 30% CC TOP-ADJ 1-TRN	0379J	UPM-45
R707	2100-2154		RESISTOR-TRMR 10K 30% CC TOP-ADJ 1-TRN	0379J	UPM-45
R708	0757-0133	2	RESISTOR 383K 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-3833-F
V701	1921-0041	1	TUBE-ELECTRON 7895 TRIODE	0192A	7895
	1200-0086	1	SOCKET-TUBE 5-CONT E5-65 DIP-SLDR	0450G	133-65-11-026
A800	00618-60104	1	BOARD ASSEMBLY, 6.3V REGULATOR	28480	00618-60104
CR801	1901-0418	1	DIODE-PWR RECT 400V 1.5A	02036	SR1846-12
CR802	1901-0050	2	DIODE-SWITCHING 80V 200MA 2NS DO-7	28480	1901-0050
CR803	1901-0050		DIODE-SWITCHING 80V 200MA 2NS DO-7	28480	1901-0050
CR804	1901-0036		DIODE-HV RECT 1KV 600MA DO-29	0271C	MP496
CR805	1901-0036		DIODE-HV RECT 1KV 600MA DO-29	0271C	MP496

See introduction to this section for ordering information

Table 6-2. Replaceable Parts

eference esignation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
F801	2110-0304	1	FUSE 1.5A 250V SLO-BLO 1.25X.25 UL IEC	0448J	MDX-1-1/2A
MP801	2110-0269	2	FUSEHOLDER-CLIP TYPE .25D-FUSE	28480	2110-0269
MP802	2110-0269		FUSEHOLDER-CLIP TYPE .25D-FUSE	28480	2110-0269
Q801			NOT ASSIGNED		
Q802	1853-0224	1	TRANSISTOR PNP SI TO-39 PD=1W FT=15MHZ	0192A	2N5415
R801	2100-0308	1	RESISTOR-VAR CONTROL WW 2 10% LIN	0246J	AW
R802	0690-2741	3	RESISTOR 270K 10% 1W CC TC=0+882	0160G	GB2741
R803	0687-2221	1	RESISTOR 2.2K 10% .5W CC TC=0+647	0160G	EB2221
VR801	1902-3129	1	DIODE-ZNR 7.5V 2% DO-7 PD=.4W TC=+.05%	0223G	FZ7448
A900	00618-6077		BOARD ASSEMBLY, MODULATOR	28480	00618-6077
C115	0160-2120	8	CAPACITOR-FXD .01UF +-1% 300VDC MICA0+70	28480	0160-2120
C122	0160-2306	3	CAPACITOR-FXD 27PF +-5% 300VDC	28480	0160-2306
C127	0140-0206		CAPACITOR-FXD 270PF +-5% 500VDC MICA	72136	DM15F271J0500WV1CR
C128	0160-2306		CAPACITOR-FXD 27PF +-5% 300VDC	28480	0160-2306
C129*	0140-0206	5	CAPACITOR-FXD 270PF +-5% 500VDC MICA *FACTORY SELECTED PART	72136	DM15F271J0500WV1CR
C130	0140-0162	1	CAPACITOR-FXD 4700PF +-10% 300VDC MICA	72136	DM20F472K0300WV1CR
C131	0160-2120		CAPACITOR-FXD .01UF +-1% 300VDC MICA0+70	28480	0160-2120
C132	0140-0206		CAPACITOR-FXD 270PF +-5% 500VDC MICA	72136	DM15F271J0500WV1CR
C138	0160-2204	4	CAPACITOR-FXD 100PF +-5% 300VDC MICA0+70	28480	0160-2204
C139	0140-0206		CAPACITOR-FXD 270PF +-5% 500VDC MICA	72136	DM15F271J0500WV1CR
C140	0160-2204		CAPACITOR-FXD 100PF +-5% 300VDC MICA0+70	28480	0160-2204
CR101	1901-0029		DIODE-PWR RECT 600V 750MA DO-29	0271C	MP496
CR102	1901-0096	1	DIODE-SWITCHING 120V 50MA 100NS	28480	1901-0096
L101	618B-60A	1	COIL, RF .350 MH	28480	618B-60A
R134*	0690-3321	1	RESISTOR 3.3K 10% 1W CC TC=0+647 *FACTORY SELECTED PART	0160G	GB3321
R144	0690-1221	5	RESISTOR 1.2K 10% 1W CC TC=0+647	0160G	GB1221
R145	0693-1031	5	RESISTOR 10K 10% 1W CC TC=0+647	0160G	HB1031
R148	0690-1541	3	RESISTOR 150K 10% 1W CC TC=0+882	0160G	GB1541
R149	0690-2741		RESISTOR 270K 10% 1W CC TC=0+882	0160G	GB2741
R150	0690-5641	1	RESISTOR 560K 10% 1W CC TC=0+882	0160G	GB5641
R151	0690-2221	3	RESISTOR 2.2K 10% 1W CC TC=0+647	0160G	GB2221
R152	0690-2221		RESISTOR 2.2K 10% 1W CC TC=0+647	0160G	GB2221
R153	0690-4741		RESISTOR 470K 10% 1W CC TC=0+882	0160G	GB4741
R154*	0690-4741	5	RESISTOR 470K 10% 1W CC TC=0+882 *FACTORY SELECTED PART	0160G	GB4741
R155	0690-4731		RESISTOR 47K 10% 1W CC TC=0+765	0160G	GB4731
R157	0690-2221		RESISTOR 2.2K 10% 1W CC TC=0+647	0160G	GB2221
R160	0693-3331	4	RESISTOR 33K 10% 2W CC TC=0+765	0160G	HB3331
R161	0693-3331		RESISTOR 33K 10% 2W CC TC=0+765	0160G	HB3331
R162	0690-1051	2	RESISTOR 1M 10% 1W CC TC=0+1000	0160G	GB1051
R186*	0690-4731	8	RESISTOR 47K 10% 1W CC TC=0+765 *FACTORY SELECTED PART	0160G	GB4731
R187	0690-4731		RESISTOR 47K 10% 1W CC TC=0+765	0160G	GB4731
R188*	0690-1041	5	RESISTOR 100K 10% 1W CC TC=0+882 *FACTORY SELECTED PART	0160G	GB1041
R189	0690-4741		RESISTOR 470K 10% 1W CC TC=0+882	0160G	GB4741
R190	0690-1541		RESISTOR 150K 10% 1W CC TC=0+882	0160G	GB1541
R191	0690-1841	1	RESISTOR 180K 10% 1W CC TC=0+882	0160G	GB1841
R192	0690-4731		RESISTOR 47K 10% 1W CC TC=0+765	0160G	GB4731
R193	0690-4721	2	RESISTOR 4.7K 10% 1W CC TC=0+647	0160G	GB4721
R194	0690-4731		RESISTOR 47K 10% 1W CC TC=0+765	0160G	GB4731
R195	0690-6821	1	RESISTOR 6.8K 10% 1W CC TC=0+647	0160G	GB6821
R196	0693-3331		RESISTOR 33K 10% 2W CC TC=0+765	0160G	HB3331
R197	0690-1251	7	RESISTOR 1.2M 10% 1W CC TC=0+1000	0160G	GB1251
R198	0690-1031	4	RESISTOR 10K 10% 1W CC TC=0+765	0160G	GB1031
R207	0690-5621	1	RESISTOR 5.6K 10% 1W CC TC=0+647	0160G	GB5621
R208	0690-8231	1	RESISTOR 82K 10% 1W CC TC=0+765	0160G	GB8231
R326	0757-0309	1	RESISTOR 61.9K 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-6192-F
R327	0757-0307	1	RESISTOR 332K 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-3323-F
R328	0757-0313		RESISTOR 392K 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-3923-F
A1000	00618-6078		BOARD ASSEMBLY, MODULATOR	28480	00618-6078
C102	0160-2120		CAPACITOR-FXD .01UF +-1% 300VDC MICA0+70	28480	0160-2120
C103*	0140-0149	1	CAPACITOR-FXD 470PF +-5% 300VDC MICA *FACTORY SELECTED PART	72136	DM15F471J0300WV1CR
C104*	0140-0197	1	CAPACITOR-FXD 180PF +-5% 300VDC MICA0+70 *FACTORY SELECTED PART	72136	DM15F181J0300WV1CR
C105	0160-2218	3	CAPACITOR-FXD 1000PF +-5% 300VDC	28480	0160-2218
C106	0160-2120		CAPACITOR-FXD .01UF +-1% 300VDC MICA0+70	28480	0160-2120
C107	0160-2218		CAPACITOR-FXD 1000PF +-5% 300VDC	28480	0160-2218
C108	0160-3493	1	CAPACITOR-FXD 2200PF +-5% 500VDC	28480	0160-3493
C109	0160-2218		CAPACITOR-FXD 1000PF +-5% 300VDC	28480	0160-2218

See introduction to this section for ordering information

Table 6-2 Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
C110	0160-2120		CAPACITOR-FXD ,01UF +-1% 300VDC MICA0+70	28480	0160-2120
C111	0160-2204		CAPACITOR-FXD 100PF +-5% 300VDC MICA0+70	28480	0160-2204
C112	0140-0190	1	CAPACITOR-FXD 39PF +-5% 300VDC	72136	DM15E390J0300WV1CR
C113	0140-0209	1	CAPACITOR-FXD 5PF +-10% 500VDC	72136	DM15C050K0500WV1CR
C114	0140-0191	1	CAPACITOR-FXD 56PF +-5% 300VDC	72136	DM15E560J0300WV1CR
C116	0160-2306		CAPACITOR-FXD 27PF +-5% 300VDC	28480	0160-2306
C117	0160-2204		CAPACITOR-FXD 100PF +-5% 300VDC MICA0+70	28480	0160-2204
C119	0140-0206		CAPACITOR-FXD 270PF +-5% 500VDC MICA	72136	DM15F271J0500WV1CR
C120	0150-0071	1	CAPACITOR-FXD 400PF +-5% 1KVDC CER	28480	0150-0071
C121	0160-2120		CAPACITOR-FXD ,01UF +-1% 300VDC MICA0+70	28480	0160-2120
C124	0160-2120		CAPACITOR-FXD ,01UF +-1% 300VDC MICA0+70	28480	0160-2120
C125	0160-2120		CAPACITOR-FXD ,01UF +-1% 300VDC MICA0+70	28480	0160-2120
C126	0140-0157	1	CAPACITOR-FXD 1857PF +-1% 500VDC MICA	72136	DM20F1857RF0500WV1CR
C142	0160-0595	2	CAPACITOR-FXD ,25UF +-10% 1,5KVDC	28480	0160-0595
R101	0690-1251		RESISTOR 1,2M 10% 1W CC TC=0+1000	01606	GB1251
R102	0690-1251		RESISTOR 1,2M 10% 1W CC TC=0+1000	01606	GB1251
R103	0693-4731	1	RESISTOR 47K 10% 2W CC TC=0+765	01606	HB4731
R104	0690-1251		RESISTOR 1,2M 10% 1W CC TC=0+1000	01606	GB1251
R105	0690-4731		RESISTOR 47K 10% 1W CC TC=0+765	01606	GB4731
R106	0690-1041		RESISTOR 100K 10% 1W CC TC=0+882	01606	GB1041
R107	0693-2731	2	RESISTOR 27K 10% 2W CC TC=0+765	01606	HB2731
R108	0690-4741		RESISTOR 470K 10% 1W CC TC=0+882	01606	GB4741
R109	0690-1041		RESISTOR 100K 10% 1W CC TC=0+882	01606	GB1041
R110	0690-4731		RESISTOR 47K 10% 1W CC TC=0+765	01606	GB4731
R115	0690-1051		RESISTOR 1M 10% 1W CC TC=0+1000	01606	GB1051
R116	0690-6811	1	RESISTOR 680 10% 1W CC TC=0+529	01606	GB6811
R118	0693-1831	1	RESISTOR 18K 10% 2W CC TC=0+765	01606	HB1831
R119	0693-1031		RESISTOR 10K 10% 2W CC TC=0+765	01606	HB1031
R120	0690-4721		RESISTOR 4,7K 10% 1W CC TC=0+647	01606	GB4721
R121	0690-2721	1	RESISTOR 2,7K 10% 1W CC TC=0+647	01606	GB2721
R122	0693-2731		RESISTOR 27K 10% 2W CC TC=0+765	01606	HB2731
R123	0690-4731		RESISTOR 47K 10% 1W CC TC=0+765	01606	GB4731
R124	0690-1221		RESISTOR 1,2K 10% 1W CC TC=0+647	01606	GB1221
R125	0690-4741		RESISTOR 470K 10% 1W CC TC=0+882	01606	GB4741
R126	0690-1031		RESISTOR 10K 10% 1W CC TC=0+765	01606	GB1031
R127	0690-1031		RESISTOR 10K 10% 1W CC TC=0+765	01606	GB1031
R128	0690-1251		RESISTOR 1,2M 10% 1W CC TC=0+1000	01606	GB1251
R129	0690-1031		RESISTOR 10K 10% 1W CC TC=0+765	01606	GB1031
R130	0690-1221		RESISTOR 1,2K 10% 1W CC TC=0+647	01606	GB1221
R131	0690-2741		RESISTOR 270K 10% 1W CC TC=0+882	01606	GB2741
R132	0690-1251		RESISTOR 1,2M 10% 1W CC TC=0+1000	01606	GB1251
R135	0693-3331		RESISTOR 33K 10% 2W CC TC=0+765	01606	HB3331
R137	0690-2711	1	RESISTOR 270 10% 1W CC TC=0+529	01606	GB2711
R138	0693-1031		RESISTOR 10K 10% 2W CC TC=0+765	01606	HB1031
R139	0693-1031		RESISTOR 10K 10% 2W CC TC=0+765	01606	HB1031
R140	0693-1031		RESISTOR 10K 10% 2W CC TC=0+765	01606	HB1031
R141	0690-1041		RESISTOR 100K 10% 1W CC TC=0+882	01606	GB1041
R142	0690-1541		RESISTOR 150K 10% 1W CC TC=0+882	01606	GB1541
R143	0690-1251		RESISTOR 1,2M 10% 1W CC TC=0+1000	01606	GB1251
R146	0690-1241	1	RESISTOR 120K 10% 1W CC TC=0+882	01606	GB1241
R159	0690-1011	1	RESISTOR 100 10% 1W CC TC=0+529	01606	GB1011
R199	0690-1221		RESISTOR 1,2K 10% 1W CC TC=0+647	01606	GB1221

See introduction to this section for ordering information

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
CHASSIS PARTS					
B1	3140-0052	1	MOTOR-AC IND SHADED-P 115V 3470-RPM	28480	3140-0052
C101	0160-0081	3	CAPACITOR-FXD .25UF +-10% 1KVDC PPR	0420J	CP5581E0254K
C118	0160-0090	1	CAPACITOR-FXD .1UF +-10% 1KVDC PPR	0420J	90P116
C123	0160-0081		CAPACITOR-FXD .25UF +-10% 1KVDC PPR	0420J	CP5581E0254K
C135	0160-0087	1	CAPACITOR-FXD .5UF +-10% 600VDC PPR	00656	P30MT208K
C136	0160-0595		CAPACITOR-FXD .25UF +-10% 1.5KVDC	28480	0160-0595
C137	0160-0089	1	CAPACITOR-FXD .1UF/.1UF +20-10% 1KVDC	0420J	90P126
C141	0160-0081		CAPACITOR-FXD .25UF +-10% 1KVDC PPR	0420J	CP5581E0254K
C143	0170-0038	2	CAPACITOR-FXD .22UF +-10% 200VDC POLYE	28480	0170-0038
C144	0180-0049	1	CAPACITOR-FXD 20UF+75-10% 50VDC AL	0420J	30D206G050CC2
C145	0170-0038		CAPACITOR-FXD .22UF +-10% 200VDC POLYE	28480	0170-0038
C362	0180-0024	5	CAPACITOR-FXD 40UF+50-10% 450VDC AL	28480	0180-0024
C363	0180-0024		CAPACITOR-FXD 40UF+50-10% 450VDC AL	28480	0180-0024
C365	0180-0024		CAPACITOR-FXD 40UF+50-10% 450VDC AL	28480	0180-0024
C403	0180-0042	4	CAPACITOR-FXD 120UF+75-10% 350VDC AL	28480	0180-0042
C404	0180-0042		CAPACITOR-FXD 120UF+75-10% 350VDC AL	28480	0180-0042
C407	0160-0675	3	CAPACITOR-FXD 4UF +-10% 1KVDC MET-POLYE	28480	0160-0675
C408	0180-0042		CAPACITOR-FXD 120UF+75-10% 350VDC AL	28480	0180-0042
C409	0180-0042		CAPACITOR-FXD 120UF+75-10% 350VDC AL	28480	0180-0042
C503	0180-0024		CAPACITOR-FXD 40UF+50-10% 450VDC AL	28480	0180-0024
C504	0180-0024		CAPACITOR-FXD 40UF+50-10% 450VDC AL	28480	0180-0024
C508	0160-0675		CAPACITOR-FXD 4UF +-10% 1KVDC MET-POLYE	28480	0160-0675
C509	0160-0675		CAPACITOR-FXD 4UF +-10% 1KVDC MET-POLYE	28480	0160-0675
C601	0180-0128	1	CAPACITOR-FXD 2800UF+50-10% 30VDC AL	28480	0180-0128
C702	0160-0265		CAPACITOR-FXD .01UF +-20% 3KVDC CER	28480	0160-0265
CR103	1901-0030	1	DIODE-PWR RECT 800V 600MA DO-29	0271C	HP495
CR603	00618-628		DETECTOR ASSEMBLY, BOLOMETER	28480	00618-628
DS40	2140-0244	1	LAMP-GLOW A1H 135/105VDC 1.2MA T-2-BULB	28480	2140-0244
F101	2110-0029	1	FUSE 3A 250V SLO-BLO 1.25X.25 UL (FOR 115V OPERATION)	0470C	313003
F101	2110-0338	1	FUSE 1.6A 250V SLO-BLO 1.25X.25 UL IEC (FOR 230V OPERATION)	0448J	MDX 1-6/10
	2110-0470	1	FUSEHOLDER-EXTR POST 20A 300V UL/IEC	0470C	345003-010
	1400-0090	1	WASHER:RUBBER 5/8" OD	0000J	OBD
	2110-0465	1	FUSEHOLDER-EXTR POST UL/IEC .25X1.25FUSE	28480	2110-0465
	2110-0467	1	NUT, HEX SINGLE CHAMFER 1/2-28 THREAD	7591E	903-070
FL301	9100-3142	1	FILTER, RFI	28480	9100-3142
J101	6188-16T	1	CABLE, SYNC IN	28480	6188-16T
J102	6188-16U	1	CABLE, SYNC OUT	28480	6188-16U
J103	6188-168	1	CABLE, EXT MOD	28480	6188-168
J104	6188-16V	1	CABLE, DELAYED SYNC OUT	28480	6188-16V
J105	1250-0144	2	CONNECTOR-RF N FEM SGL HOLE FR	28480	1250-0144
J106	1250-0144		CONNECTOR-RF N FEM SGL HOLE FR	28480	1250-0144
J301	1251-0148	1	CONNECTOR-AC PWR HP-8 MALE FLG-MTG	05056	AC3G
J303	1251-1036		CONNECTOR 7-PIN F HEXAGONAL	05008	M78
L102	9170-0029		CORE-SHIELDING BEAD	01889	56-590-65A2/4A
M101	1120-1277	1	METER:0-181 MA	28480	1120-1277
P302	1251-0194		CONNECTOR-PC EDGE 15-CONT/ROW 1-ROW	03390	91-6915-1113-00
Q1	1853-0252	1	TRANSISTOR PNP SI TO-3 PD=150W FT=4MHZ	28480	1853-0252
R111	2100-0059	1	R:VAR COMP 3X1 MEGOHM 10% LIN 2W	28480	2100-0059
R112	2100-0029	2	RESISTOR-VAR CONTROL CC 250K 10% LIN	02588	380
R113	2100-0029		RESISTOR-VAR CONTROL CC 250K 10% LIN	02588	380
R114			N.S.R. PART OF R111		
R117	2100-0025	3	RESISTOR-VAR CONTROL CC 1.5K 10% LIN	02588	380C2-2-1/4W-1501-K
R133	2100-0025		RESISTOR-VAR CONTROL CC 1.5K 10% LIN	02588	380C2-2-1/4W-1501-K
R136	2100-0047	2	RESISTOR-VAR CONTROL CC 1M 20% 10CW	02588	380
R147			N.S.R. PART OF R111 AND R114.		
R156	2100-0025		RESISTOR-VAR CONTROL CC 1.5K 10% LIN	02588	380C2-2-1/4W-1501-K
R158	2100-0051	1	RESISTOR-VAR CONTROL CC 20K 10% 10CW	02588	380
R168	2100-0047		RESISTOR-VAR CONTROL CC 1M 20% 10CW	02588	380
R169	0690-1041		RESISTOR 100K 10% 1W CC TC=0+882	01606	GB1041
R170	2100-0028	4	RESISTOR-VAR CONTROL CC 50K 10% LIN	02588	380
R171	0693-1531	1	RESISTOR 15K 10% 2W CC TC=0+765	01606	HB1531
R172	0693-8231	1	RESISTOR 82K 10% 2W CC TC=0+765	01606	HB8231
R173	2100-0028		RESISTOR-VAR CONTROL CC 50K 10% LIN	02588	380
R174	2100-0127	1	R:VAR 100K OHM 10% 8W	28480	2100-0127
R175	2100-0028		RESISTOR-VAR CONTROL CC 50K 10% LIN	02588	380
R176	0693-4721	2	RESISTOR 4.7K 10% 2W CC TC=0+647	01606	HB4721
R177	0693-4721		RESISTOR 4.7K 10% 2W CC TC=0+647	01606	HB4721

See introduction to this section for ordering information

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
R178	2100-0028		RESISTOR-VAR CONTROL CC 50K 10% LIN	02588	380
R204	0687-1011	1	RESISTOR 100 10% .5W CC TC=0+529	01606	EB1011
R205	0690-1221		RESISTOR 1.2K 10% 1W CC TC=0+647	01606	GB1221
R209	0757-0815	1	RESISTOR 562 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-562R-F
R211	0687-2261	1	RESISTOR 22M 10% .5W CC TC=0+1059	01606	EB2261
R376	0757-0123	1	RESISTOR 34.8K 1% .125W F TC=0+-100	01608	CC
R421	0687-4741	4	RESISTOR 470K 10% .5W CC TC=0+882	01606	EB4741
R422	0687-4741		RESISTOR 470K 10% .5W CC TC=0+882	01606	EB4741
R423	0687-4741		RESISTOR 470K 10% .5W CC TC=0+882	01606	EB4741
R424	0687-4741		RESISTOR 470K 10% .5W CC TC=0+882	01606	EB4741
R516	0761-0099	2	RESISTOR 430K 5% 1W MO TC=0+-200	03418	FP-32
R517	0761-0099		RESISTOR 430K 5% 1W MO TC=0+-200	03418	FP-32
R520	0757-0870		RESISTOR 825K 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-8253-F
R521	0757-0139		RESISTOR 1.1M 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-1104-F
R522	0757-0139		RESISTOR 1.1M 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-1104-F
R523	2100-0465	1	RESISTOR-VAR CONTROL CC 1M 20% LIN	02588	380
R524	0757-0133		RESISTOR 383K 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-3833-F
R525	0757-0059	2	RESISTOR 1M 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-1004-F
R526	0757-0059		RESISTOR 1M 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-1004-F
R527*	0698-3260	1	RESISTOR 464K 1% .125W F TC=0+-100	01606	CC
			*FACTORY SELECTED PART		
RT101	0839-0006	1	THERMISTOR DISC 10-OHM TC=-3.8%/C-DEG	28480	0839-0006
S1	3101-1395	1	SWITCH-PB DPDT-DB ALTNG 10.5A 250VAC	0100H	53-67280-121/A1H
S101	6188-19B	1	SWITCH ASSEMBLY, MOD	28480	6188-19B
S102	00618-625	1	SWITCH ASSEMBLY, MOD	28480	00618-625
S103	3102-0001	1	SWITCH-SENS SPDT STD 15A 250VAC	0E957	BZ-2RS
S306	3101-0033	1	SWITCH-SL DPDT-NS STD .5A 125VAC/DC	05058	11A-1009A
T1	9100-1703	1	TRANSFORMER;POWER	28480	9100-1703
TB1	0360-0064	1	BARRIER BLOCK 11-TERM SINGLE SOLDER LUG	04506	354-17-11-001
V101	1932-0045	1	TUBE-ELECTRON 12AT7 TRIODE-DUAL	24972	ECC 81
	1200-0003	8	SOCKET-TUBE 9-CONT	04506	121-31-12-104
	1220-0007	1	SHIELD;TUBE	7178E	151-11-33-013(101)
V102	1930-0013	3	TUBE-ELECTRON 6AL5 DIODE-DUAL	33173	6AL5
	1200-0017	4	SOCKET-TUBE 7-CONT SLDR-EYE	04506	111-39-11-018
V103	1932-0046	7	TUBE-ELECTRON 12AU7 TRIODE-DUAL	33173	12AU7
	1220-0009	7	SHIELD-TUBE	7178E	151-11-23-012
	1200-0003		SOCKET-TUBE 9-CONT	04506	121-31-12-104
V104	1932-0046		TUBE-ELECTRON 12AU7 TRIODE-DUAL	33173	12AU7
	1200-0003		SOCKET-TUBE 9-CONT	04506	121-31-12-104
	1220-0009		SHIELD-TUBE	7178E	151-11-23-012
V105	1932-0046		TUBE-ELECTRON 12AU7 TRIODE-DUAL	33173	12AU7
	1200-0003		SOCKET-TUBE 9-CONT	04506	121-31-12-104
	1220-0009		SHIELD-TUBE	7178E	151-11-23-012
V106	1930-0013		TUBE-ELECTRON 6AL5 DIODE-DUAL	33173	6AL5
	1200-0017		SOCKET-TUBE 7-CONT SLDR-EYE	04506	111-39-11-018
V107	1932-0046		TUBE-ELECTRON 12AU7 TRIODE-DUAL	33173	12AU7
	1200-0003		SOCKET-TUBE 9-CONT	04506	121-31-12-104
	1220-0009		SHIELD-TUBE	7178E	151-11-23-012
V108	1930-0013		TUBE-ELECTRON 6AL5 DIODE-DUAL	33173	6AL5
	1200-0017		SOCKET-TUBE 7-CONT SLDR-EYE	04506	111-39-11-018
V109	1932-0046		TUBE-ELECTRON 12AU7 TRIODE-DUAL	33173	12AU7
	1200-0003		SOCKET-TUBE 9-CONT	04506	121-31-12-104
	1220-0009		SHIELD-TUBE	7178E	151-11-23-012
V110	1941-0005	1	TUBE-ELECTRON 2D21 THYRATRON	33173	2D21
	1200-0017		SOCKET-TUBE 7-CONT SLDR-EYE	04506	111-39-11-018
V111	1932-0046		TUBE-ELECTRON 12AU7 TRIODE-DUAL	33173	12AU7
	1200-0003		SOCKET-TUBE 9-CONT	04506	121-31-12-104
	1220-0009		SHIELD-TUBE	7178E	151-11-23-012
V114	6188-95G	1	ELECTRON TUBE, SKK 1316 KLYSTRON (FOR 618C ONLY)	28480	6188-95G
V114	620A-95C	1	ELECTRON TUBE, SKK 1315 KLYSTRON (FOR 620B ONLY)	28480	620A-95C
V115	1932-0046		TUBE-ELECTRON 12AU7 TRIODE-DUAL	33173	12AU7
	1200-0003		SOCKET-TUBE 9-CONT	04506	121-31-12-104
	1220-0009		SHIELD-TUBE	7178E	151-11-23-012
620B MISC. ONLY					
	00620-60035	1	BOARD ASSEMBLY, RESISTOR	28480	00620-60035
	620A-34BB	1	ATTENUATOR ASSEMBLY	28480	620A-34BB
	00620-623	1	BOLOMETER ASSEMBLY	28480	00620-623
	00620-624	1	PROBE ASSEMBLY, SAMPLE	28480	00620-624
618C MISC. ONLY					
	6188-27	1	FILTER, R.F.	28480	6188-27
	6188-34AA	1	ATTENUATOR ASSEMBLY	28480	6188-34AA
	6188-35	1	DRIVE ASSEMBLY, ATTENUATOR	28480	6188-35
	6188-36AK	1	FILTER, REPELLER ASSEMBLY	28480	6188-36AK
	6188-36AP	1	CAPACITOR/ATTENUATOR HOUSING	28480	6188-36AP

See introduction to this section for ordering information

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
	6188-368C	1	PLUNGER ASSEMBLY	28480	6188-368C
	6188-47C	1	SPACER, DIAL WINDOW	28480	6188-47C
	6188-408	1	COVER, FREQ DIAL	28480	6188-408
	00618-024	1	BRACKET, MODULATOR POTS	28480	00618-024
	00618-622	1	CONTROL ASSEMBLY, FREQ.	28480	00618-622
	00618-623	1	BOLOMETER ASSEMBLY	28480	00618-623
	00618-640	1	PROBE ASSEMBLY, SAMPLE	28480	00618-640
	00618-60105	1	BOARD ASSEMBLY, TRACKING RESISTOR	28480	00618-60105
618C/620B MISC.					
	1251-0194	2	CONNECTOR-PC EDGE 15-CONT/ROW 1-ROW	03390	91-6915-1113-00
	1251-0234	1	CONNECTOR-PC EDGE 6-CONT/ROW 1-ROW	03390	91-6906-5500-00
	1251-1036	2	CONNECTOR 7-PIN F HEXAGONAL	05008	M7S
	1251-1037	1	CONNECTOR 7-PIN M HEXAGONAL	05008	M7P
	6188-528	1	COVER, SOCKET HOUSING	28480	6188-528
	00618-628	2	DETECTOR ASSEMBLY, BOLOMETER	28480	00618-628
	6188-40P	1	DIAL, FREQUENCY VERNIER	28480	6188-40P
	6188-52	1	SOCKET ASSEMBLY	28480	6188-52
	6188-40H	1	DIAL ASSEMBLY, PULSE WIDTH	28480	6188-40H
	6188-40G	1	DIAL ASSEMBLY, PULSE RATE	28480	6188-40G
	6188-40F	1	DIAL ASSEMBLY, PULSE DELAY	28480	6188-40F
	6188-40C	1	DIAL, ATTENUATOR	28480	6188-40C
	6188-40E	1	DIAL, POWER SET	28480	6188-40E
	0340-0020	1	STANDOFF-RND .75LG 6-32THD .375OD STTT	28480	0340-0020
	0370-0028	1	KNOB:ROUND BLACK 1" DIA	28480	0370-0028
	0370-0029	1	KNOB:BLACK W/ARROW 1" DIA 1/4" SHAFT	28480	0370-0029
	0370-0035	1	KNOB:SKIRTED BAR 1" DIA	28480	0370-0035
	0370-0038	1	KNOB:BLACK 1-5/8" DIA	28480	0370-0038
	0370-0050	1	HANDLE:CRANK ONLY 3/8" OD	28480	0370-0050
	00618-624	1	PULSER ASSEMBLY	28480	00618-624
	1200-0053	2	SOCKET-TUBE 7-CONT DIP-SLDR	04508	111-51-11-069
	1200-0062	2	SOCKET-TUBE 9-CONT DIP-SLDR	04506	121-51-11-060
	1200-0062		SOCKET-TUBE 9-CONT DIP-SLDR	04506	121-51-11-060
	1200-0053		SOCKET-TUBE 7-CONT DIP-SLDR	04506	111-51-11-069
	5020-0234	1	HUB, DIAL	28480	5020-0234
	5020-0278	1	GEAR, OFFSET TOOTH	28480	5020-0276
	5040-0216	1	WINDOW, DIAL ATTENUATOR	28480	5040-0216
	6188-38	1	WRENCH, SOCKET	28480	6188-38
	00618-6077	2	BOARD ASSEMBLY, MODULATOR	28480	00618-6077
	00618-6078	2	BOARD ASSEMBLY, MODULATOR	28480	00618-6078
	00618-634	1	CABINET ASSEMBLY	28480	00618-634
	00618-635	1	RACK CABINET ASSEMBLY	28480	00618-635
	8120-1378	1	CABLE ASSY 18AWG 3-CNDCT JGK-JKT .25-OD	28480	8120-1378
	1251-2357	1	CONNECTOR-AC PWR HP-9 MALE FLG-MTG	05056	EAC-301
	00618-00077	1	SCREEN, CABINET	28480	00618-00077
	7120-4162	4	LABEL, WARNING"HAZARDOUS VOLTAGE"LARGE	28480	7120-4162
	7120-4163	3	LABEL,WARNING""HAZARDOUS VOLTAGE"SMALL	28480	7120-4163
	7120-5087	1	LABEL, WARNING"TO PREVENT ELECT. SHOCK"	28480	7120-5087
	00618-60107	1	VOLTAGE DIVIDER BOARD ASSEMBLY (INCLUDES R520-522,R524,R525 & R527)	28480	00618-60107
	6188-16L	1	CABLE, SHIELDED	28480	6188-16L
	00618-00075	1	BRACKET, 6.3V REGULATOR	28480	00618-00075
	0340-0875	1	INSULATOR-XSTR THRM-CNDCT	28480	0340-0875

See introduction to this section for ordering information

Table 6-3. Code List of Manufacturers

Mfr Code	Manufacturer Name	Address	Zip Code
00000	U.S.A. COMMON	ANY SUPPLIER OF THE U.S.	
0100H	ILLUMINATED PRODUCTS INC	ANAHEIM CA	
00656	AEROVOX CORP	NEW BEDFORD MA	02741
0160G	ALLEN-BRADLEY CO	MILWAUKEE WI	
0188G	FERROXCUBE CORP	SAUGERTIES NY	
0192A	RCA CORP SOLID STATE DIV	SOMERVILLE NJ	
0203G	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX AZ	
0223G	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW CA	
0E957	MICRO-SWITCH CO	BALA CYNWYD PA	19004
0246J	CTS OF ASHVILLE INC	SKYLAND NC	
0258B	CLAROSTAT MFG CO INC	DOVER NH	
14830	RAYTHEON CO SPL U-WAVE DEVICES DIV	WALTHAM MA	02154
0271C	GENERAL INSTR CORP SEMIDON PROD GP	HICKSVILLE NY	
0299E	MEPCO/ELECTRA CORP	MINERAL WELLS TX	
0329B	CORNING GLASS WORKS (BRADFORD)	BRADFORD PA	
24972	AEG-TELEFUNKEN CORP	ENGLEWOOD CLIFF NJ	07632
0339D	METHODE ELECTRONICS INC	CHICAGO IL	
0341B	CORNING GLASS WORKS (WILMINGTON)	WILMINGTON NC	
28480	HP DIV 00 CORPORATE	PALO ALTO CA	
0374D	BOURNS INC TRIMPOT PROD DIV	RIVERSIDE CA	
33173	GE CO TUBE DEPT	OWENSBORO KY	42301
0379J	CTS OF BROWNSVILLE INC	BROWNSVILLE TX	
0420J	SPRAGUE ELECTRIC CO	NORTH ADAMS MA	
0448J	BUSSMAN MFG DIV OF MCGRAW-EDISON CO	ST LOUIS MO	
0450G	TRW ELEK COMPONENTS CINCH DIV	ELK GROVE VLGE IL	
72136	ELECTRO MOTIVE CORP SUB IEC	WILLIMANTIC CT	06226
0457I	AMPEREX ELECTRONIC CORP	HICKSVILLE LI NY	
74276	SIGNALITE DIV GENERAL INST CORP	NEPTUNE NJ	07753
0470C	LITTELFUSE INC	DES PLAINES IL	
0500B	WINCHESTER ELEK DIV LITTON IND INC	OAKVILLE CT	
0505G	SWITCHCRAFT INC	CHICAGO IL	
0552D	DALE ELECTRONICS INC	COLUMBUS NE	
0599A	CIFTE	FR	

APPENDIX I

ILLUSTRATED PARTS IDENTIFICATION

MODELS 618C-620B

SHF
SIGNAL GENERATOR

REF.	STOCK NO.	DESCRIPTION	QTY.
1		See Figures 2 & 3	
2		See Figure 4	
3		See Figures 5, 6, 7 & 8	
4		See Figure 9	
5		See Figures 13, 14 & 15	

REF.	STOCK NO.	DESCRIPTION	QTY.

REF.	STOCK NO.	DESCRIPTION	QTY.

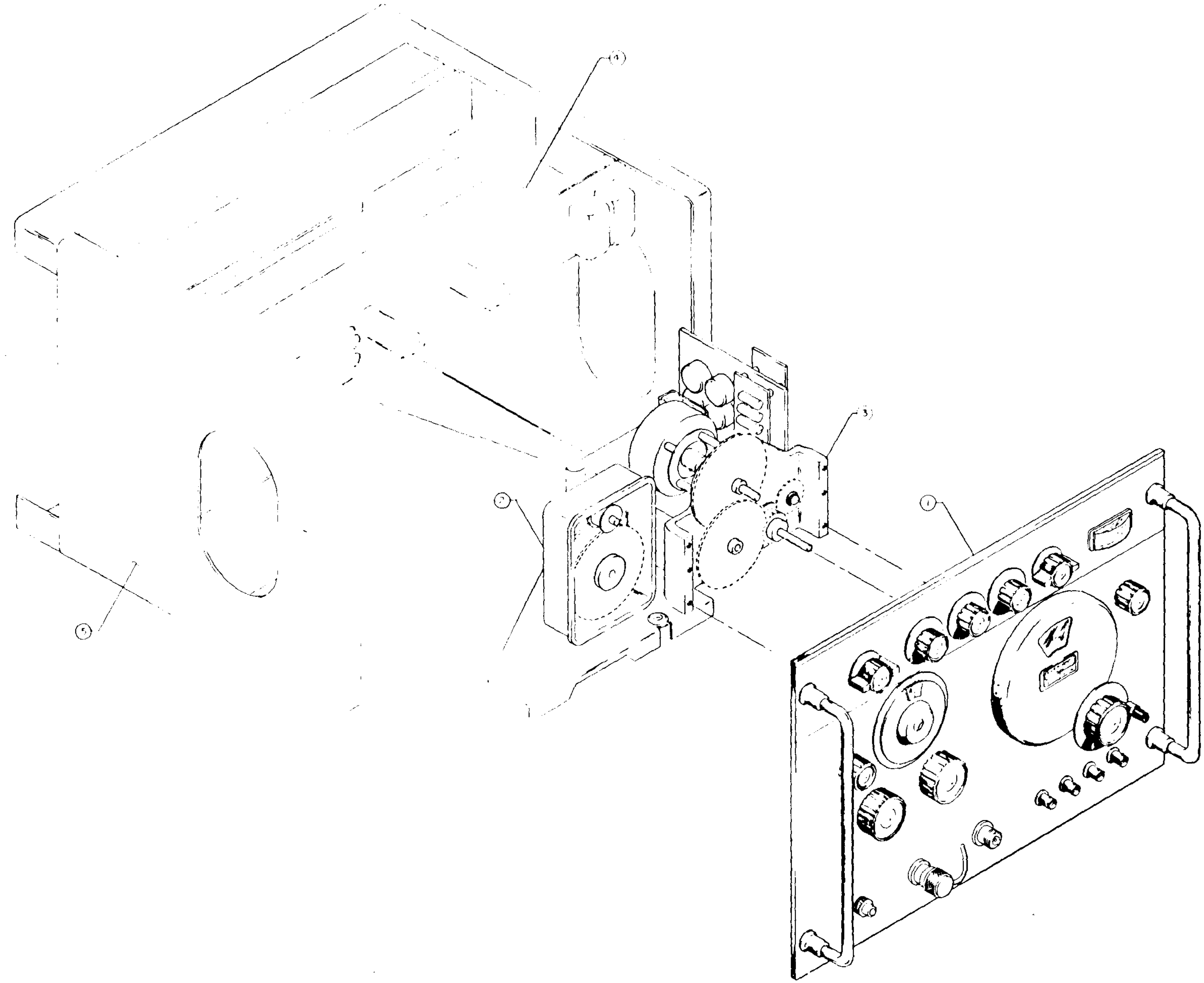


Figure I-1. HP Model 618C/620B S.H.F. Signal Generator, General Arrangement

Parts List for Figure I-2

REF.	STOCK NO	DESCRIPTION	QTY.
1	2990-0002	Screw, Truss head ss, 10-24 thd, 1/2 in. lg	17
2	2530-0003	Screw, Flat head ss, 8-32 thd, 1/2 in. lg	4
3	2930-0004	Screw, Flat head ss, 10-24 thd, 1/2 in. lg	1
4	2550-0009	Screw, Bind. head, ss, with ext lock, 8/32 thd, 1/2 in. lg	3
5	08614-626	Cap Assy, RF Conn	1
6	2370-0001	Screw, Flat head ss, 6-32 thd, 1/4 in. lg	4
7	2210-0002	Screw, Flat head ss, 4-40 thd, 1/4 in. lg	3
8	2550-0007	Screw, Bind. head ss, with ext lock, 8-32 thd, 3/8 in. lg	1
9	0520-0025	Screw, Round head ss, 2-56 thd, 1/8 in. lg	2
10	2200-0010	Screw, Round head ss, 4-40 thd, 3/4 in. lg	4
11	3030-0001	Screw, Allen dr set, 8-32 thd, 3/16 in. lg	24
12	3050-0032	Washer, 5/16 in. od, 0.190 in. id, brass	13
13	0520-0015	Screw, Round head, 2-56 thd, 5/16 in. lg	2
14	2190-0016	Washer, Int lock, 1/2 in. od	7

REF.	STOCK NO.	DESCRIPTION	QTY.
15	2950-0001	Nut, 1/2 in. wide, 3/8-32 thd, br	7
16	0370-0035	Knob, 1 in. dia blk, 1/4 in. shaft, w/arrow	2
17		Not assigned	
18	0370-0029	Knob, 1 in. dia blk, 1/4 in. shaft, w/arrow	2
19	0370-0038	Knob, 1-5/8 in. dia blk, 1/4 in. shaft	2
20	0370-0050	Knob, 3/8 in. dia blk, crank handle	1
21	1410-0033	Bushing, Knob 0.219 od, 0.140 id	1
22	2410-0001	Screw, Oval Phillips, 6-32 thd, 5/8 in. lg	1
23	618B-40P	Dial Assy, Vernier	1
24	618B-40H	Dial, Pulse width	1
25	618B-40F	Dial, Pulse delay	1
26	618B-40G	Dial, Pulse rate	1
27	618B-3E	Handle, Panel	2
28	61B-3AT	Ferrule, Panel handle	4
29	1250-0141	Body, Clamp	2
30	1250-0142	Nut, Clamp	2
31	1250-0143	Washer, Shouldered	2
32	1250-0144	Body, Connector	2
33	1250-0145	Gasket, V groove	2
34	1250-0146	Washer, Flat	2

REF.	STOCK NO.	DESCRIPTION	QTY.
35	1250-0147	Nut, Connector	2
36	1250-0148	Washer, Insulating	2
37	1250-0017	Contact, Female	2
38	3050-0016	Washer, no. 6, 9/32 in. od, nickel pl brass	1
39	5040-0214	Bead A (618C)	2
	5040-0215	Bead C (620B) (signal side)	1
40	3101-1248	Switch, Push	1
41	5020-0234	Hub, Dial 1 in. dia	1
42	61B-40D-4	Plate, Freq dial	1
43	00618-00076	Blank Dial, Freq	1
44	618B-40E	Dial, Power set	1
45	618B-40C	Dial, Attenuator (618C)	1
	620A-40A	Dial, Atten. (620B)	1
46	5040-0216	Indicator, Dial marked atten	1
47	618B-47C	Spacer, Window	2
48	61B-40D-1	Window, Dial (618C)	1
	620A-40B	Window, Dial (620B)	1
49	00618-00072	Cover, Dial	1
50	5001-0107	Cover, Attenuator dial	1
51	00618-00073	Panel, Front	1
	00618-00074	Panel, Front (rack mtg)	1
52	2190-0014	Washer, Int lock 1/2 in. od	2
53	3050-0017	Washer, 3/8 in. od, 0.26 in. id, bronze	5
54	618B-16S-T-U-V	Cable Assy	4
55	2140-0244	Lamp, Glow	1

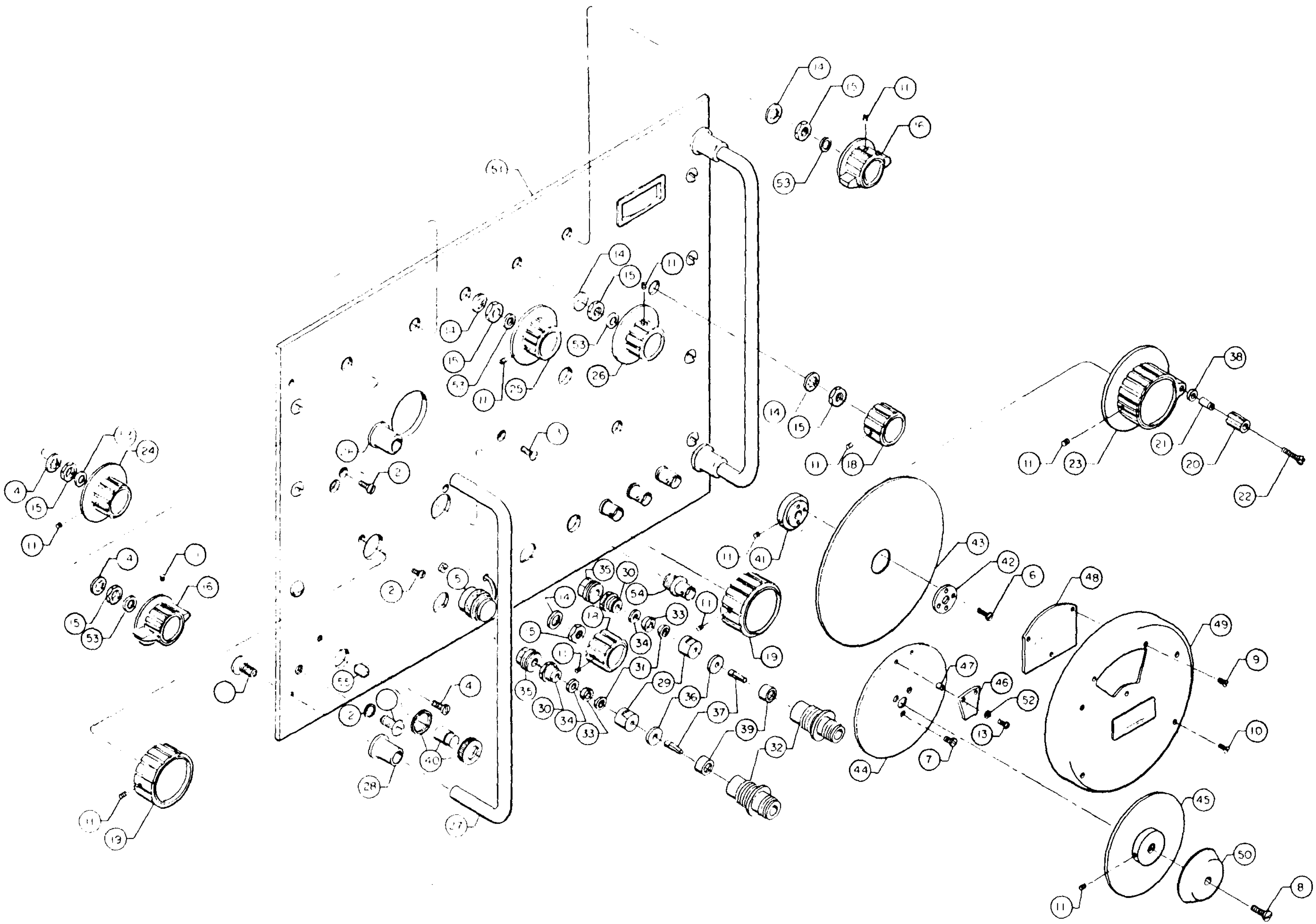


Figure I-2. HP Model 618C/620B S.H.F. Signal Generator, Control Panel, Front View

Parts List for Figure I-3

REF.	STOCK NO.	DESCRIPTION	QTY.
1	5020-0319	Shaft, 1/4 in. ss, 1-3/16 in. lg	5
2	1410-0003	Bushing, Threaded 3/8-32, 1/2 in. lg	5
3	5000-0206	Washer, Spring 9/16 in. dia	5
4	5020-0238	Head Coupler 3/4 in. dia	5
5	3030-0001	Screw, Allen dr set 8-32 thd, 3/16 in. lg	10
6	5020-0318	Shaft	5
7	2950-0042	Nut, 1 in. wide, 3/4-20 thd, br	2
8	2190-0051	Washer, Int lock 1 in. od	2
9	618B-16S-T-U-V	Cable Assy	4
10	2190-0016	Washer, Int lock 1/2 in. od	2
11	2100-0047	Resistor, Variable	2
12	3101-1395	Switch, Push	1
13	2280-0012	Screw, Round head, 4-40 thd, 3/4 in. lg	2
14	1120-1277	Meter	1

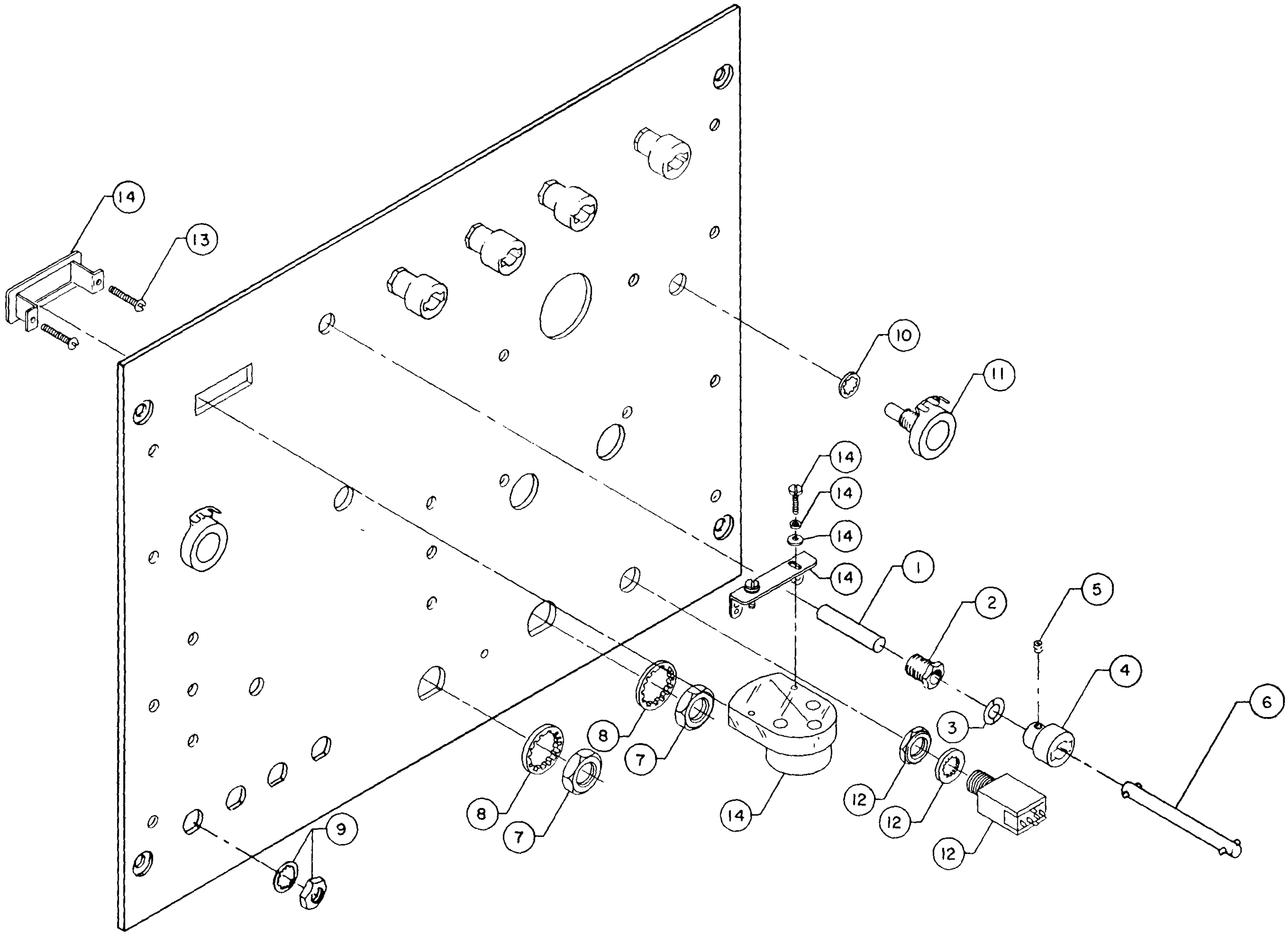


Figure I-3. HP Model 618C/620B S.H.F. Signal Generator, Control Panel, Rear View

Parts List for Figure I-4

REF.	STOCK NO.	DESCRIPTION	QTY.
1	618B-35A	Housing	1
2	618B-35B	Guide, Rack	1
3	618B-35D	Spacer, Bearing	1
4	618B-35E	Tube, Drive	1
5	618B-35G	Hub, Gear	1
6	618B-35H	Bracket, Gear	1
7	618B-35I	Shaft, Monitor	1
8	618B-35J	Shaft, Attenuator	1
9	618B-35K	Gear, Idler	1
10	618B-35L	Gear, Idler	1
11	618B-35M	Gear, Driven	1
12	618B-35N	Gear, Driven	1
13	618B-35P -S	Gear, Rack	1
14	618B-35P -L	Gear, Rack	1
15	5020-0233	Collar, 1/4 in. shaft 1/2 in. dia	3
16	5000-0206	Washer, Spring, 9/16 in. dia	4
17	5020-0256	Shaft	2
18	618B-35Q	Gear, Attenuator dial	1
19	618B-35R	Gear, Monitor	1

REF.	STOCK NO.	DESCRIPTION	QTY.
20	618B-35S	Gear, Drive	1
21	618B-35T	Gear, Drive	1
22	618B-35U	Gear, Drive	1
23	618B-35V	Gear, Drive	1
24	620A-91A	Spring, Rack Load	1
25	5020-3368	Collar, 3/16" id, 1/2" od	1
26	1410-0004	Bearing, Ball, 5/8 od, 1/4 id	1
27	1410-0007	Bearing, Ball, 1/2 od, 3/16 id	2
28	1410-0012	Bearing, Ball 7/8 od, 3/8 id	2
29	1460-0048	Spring, Extension	4
30	2210-0002	Screw, Flat head ss, 4-40 thd, 1/4 in. lg	9
31	2190-0003	Washer, Split lock for no. 4 screw	3
32	2260-0001	Nut, 1/4 in. wide 4-40 thd, ss	3
33	0380-0017	Spacer	1
34	3030-0001	Screw, Allen dr set 8-32 thd, 3/16 in. lg	13

REF.	STOCK NO.	DESCRIPTION	QTY.
35	3030-0007	Screw, Allen dr set 4-40 thd, 1/8 in. lg	8
36	3050-0017	Washer, 3/8 in. od 0.26 in. id, bronze	A/R
37	2550-0007	Screw, Bind. head ss, 8-32 thd, 3/8 in. lg, w/ ext lock	1
38	2420-0001	Screw, Bind. head ss, 6-32 thd, 5/16 in. lg, w/ ext lock	2
39	2380-0004	Screw, Fil head ss, 6-32 thd, 3/4 in. lg	1
40	3050-0106	Washer, Brass .48 od, .338 id	6
41	3050-0074	Washer, Be Cu .75 od .255 id	1
42	3030-0003	Screw, Allen dr cap 6/32 thd, 3/8 in. lg	1
43	1400-0015	Clamp, Cable 1/4 in. dia, steel	1
44	3050-0025	Washer, Be Cu 1.25 od, .2812 id	1

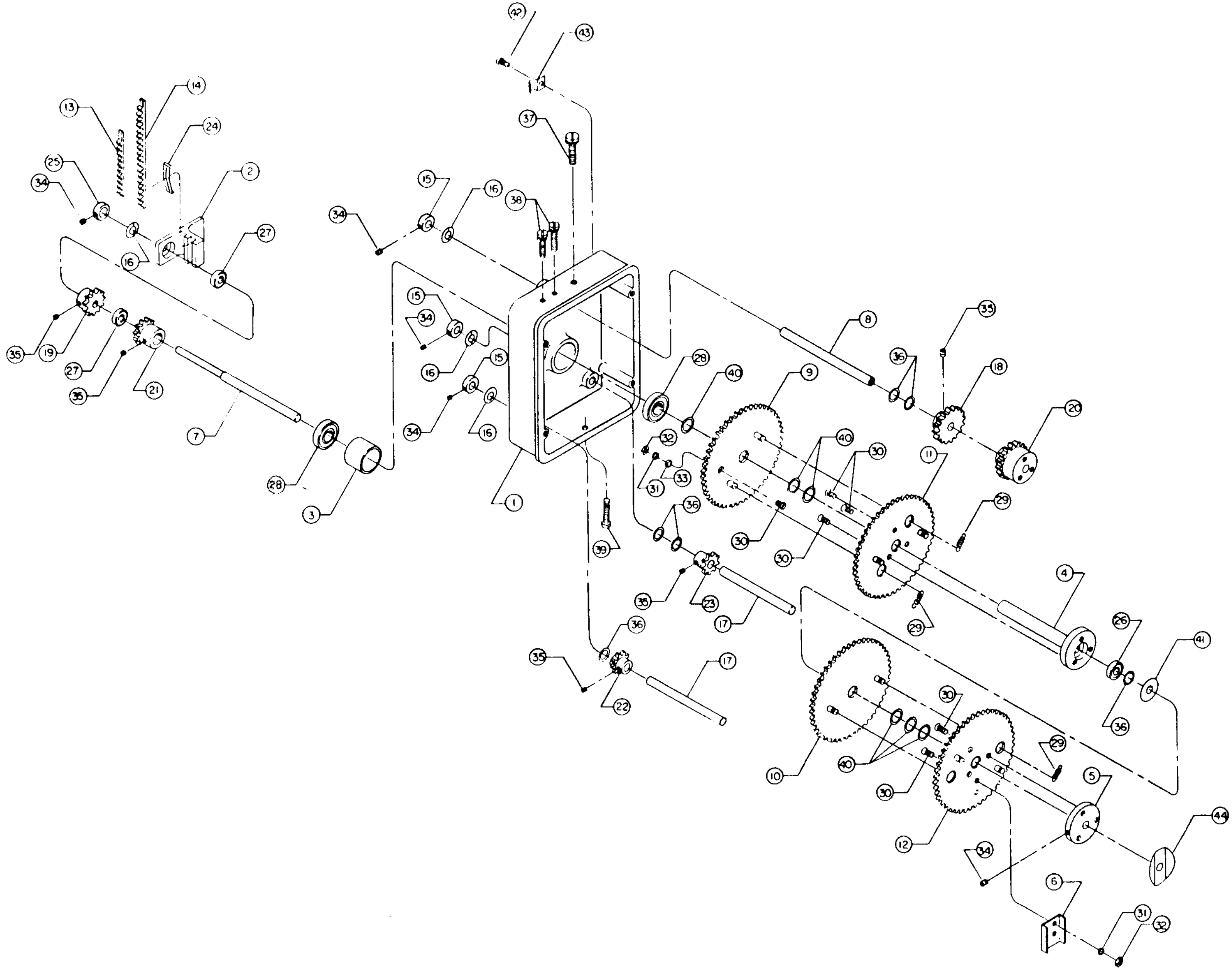


Figure I-4. HP Model 618C/620B S. H. F. Signal Generator, Attenuator Drive Mechanism

Parts List for Figure I-5

REF.	STOCK NO.	DESCRIPTION	QTY.
1	0160-0088	Capacitor, Fxd paper 0.25 uf 10% 1.5K vdcw	1
2	1400-0525	Bracket, Mtg footed	2
3	1410-0009	Bearing, Ball .75 od .25 bore	2
4	1460-0048	Spring, Extension .688 lg	4
5	2100-0127	Resistor, Variable 100K ohms 10%, 8w	1
6	3102-0001	Switch, SPDT	1
7	3102-0002	Lever, Switch actuator	1
8	5020-0233	Collar, 1/4 in. shaft 1/2 in. dia	2
9	5020-0278	Gear, Offset tooth	1
10	5020-0340	Shaft, 1/4 in. ss 1-5/16 in. long	1
11	5020-0349	Shaft, 2-3/4 in. long	1
12	608D-47J	Spacer, Stop gear	1
13	618B-27	Filter Assy	1
14	618B-36P	Gear, Idler	1
15	618B-36L	Retainer, Freq	2
16	618B-36Q	Gear, Freq	1
17		NOT ASSIGNED	
18	00618-20067	Pot Mounting Assembly	1
19	618B-36AX	Gear, Freq drive	1
20	618B-36N	Gear, Pot drive	1
21	618B-36R	Gear, Freq	1
22	00618-242	Coupler, Potentiometer	1
23	00618-2061	Cavity Assy	1
24	620A-36AA	Housing	1
25	618B-3D	Shield, Tube	1
26	618B-3G	Contact, Tube	2
27	618B-3C	Nut, Tube	1
28	00618-240	Board, Terminal	1
29	2100-0028	Resistor, Variable 50K ohms 10% 2.25 w	4
30	618B-34AA	Attenuator Assy	1
31	618B-3F	Spring, Tube	1
32	00618-226	Probe, Bolometer	1
33	620A-34D	Sleeve, Dielectric	1
34	1250-0005	Nut, Connector	1
35	1250-0006	Washer, Connector	1
36	1250-0007	Gasket, Connector	1
37	1250-0008	Clamp, Connector	1
38	1250-0141	Clamping Body, RF connector	1
39	1250-0142	Nut, Clamp	1
40	620A-34A -1	Stop, Attenuator	1
41	620A-28C	Stop, Plunger	1
42	618B-3A	Clamp, Guide	1
43	618B-35B	Guide, Rack	1
44	620A-91A	Spring, Rack load	1
45	618B-35P -L	Gear, Rack	1
46	618B-35P -S	Gear, Rack	1
47	00618-6070	Socket Assembly	1
48	1200-0014	Socket, 4 Pin tube ring mounting	1
49	8160-0008	Braid, RF .25 dia aluminum	6"
50	1250-0143	Washer, Shouldered	1
51	1250-0145	Gasket	1
52	00618-00078	Bracket	1
53	618B-52B	Cover, Housing	1
54	5020-0621	Nut, 11/32 in. gland 9/16 in. dia	1
55	3050-0022	Washer, 7/16 in. od 5/16 in. id brass	2
56	0890-0002	Rubber, Tubing	1/4"
57		NOT ASSIGNED	
58		NOT ASSIGNED	
59	2950-0033	Nut, 1/2 in. wide 3/8-32 thd, br	4
60	3030-0001	Screw, Allen dr set 8-32 thd, 3/16 in. lg	13
61	3030-0007	Screw, Allen dr set 4-40 thd, 1/8 in. lg	1
62	618B-88A	Ring, Seating	1
63	1250-0146	Washer, Flat	1
64	1250-0147	Nut, Retainer	1
65	1250-0148	Washer, Insulating	1
66	1950-0004	Klystron	1
68	620A-90C	Nut, Tube collet	1
69	2360-0018	Screw, Round head ss 6-32 thd, 1-1/2 in. lg	5
70	2190-0007	Washer, Int lock for no. 6 screw	7
71	3050-0066	Washer, 3/8 in. od 0.147 in. id, brass	20
72	3030-0064	Screw, Cap sh 6-32 x .625	6
73	2680-0246	Screw, Hex Head ss 10-24 Thd, 7/8 in. lg	1
74	2190-0011	Washer, Int lock for no. 10 screw	1
75	3050-0019	Washer, Flat brass 1/2 in. od	1
76	3050-0005	Washer, 3/8 in. od for no. 6 screw fiber	4
77		NOT ASSIGNED	
78	2580-0003	Nut, 11/32 in. wide 8-32 thd, w/lock	1
79	2390-0007	Screw, Bind. head ss 6-32 thd, 5/16 in. lg	1
80	2550-0009	Screw, Bind. head ss 8-32 thd, 1/2 in. lg	5
81	618B-47A	Support, Bracket	1
82	3030-0016	Screw, Allen dr cap 6-32 thd, 1/2 in. lg	1
83	0520-0004	Screw, Mach brs 2-56 x 3/16 fil hd sd ni-p	2
84	00618-628	Bolometer Detector Assy	1
85	1251-0234	Connector, F.C. board 6 pin	1
86		NOT ASSIGNED	

Parts List for Figure I-5 (Cont'd)

REF.	STOCK NO.	DESCRIPTION	QTY.
87		NOT ASSIGNED	
88	2190-0004	Washer, Int lock for no. 4 screw	2
89	2550-0007	Screw, Bind. head ss 8-32 thd, 3/8 in. lg	6
90	2190-0009	Washer, Int lock for no. 8 screw	2
91	0380-0003	Spacer, 1/4 in. od., 1/8 in. lg	1
92	2390-0009	Screw, Bind. head ss 6-32 thd, 3/8 in. lg	6
93	2220-0003	Screw, Fil head ss 4-40 thd, 5/16 in. lg	3
94	3050-0229	Washer, 0.250 in. od, 0.117 in. id, ss	1
95	2190-0061	Washer, Split lock for no. 4 screw	1
96	2200-0006	Screw, Round head, ss, 4-40 thd, 3/8 in. lg	3

REF.	STOCK NO.	DESCRIPTION	QTY.
97	00618-632	Board Assy, Bolometer amplifier	1
98	00618-640	Sample Probe Assy	1
99	2370-0003	Screw, Flat head ss 6-32 thd, 1/2 in. lg	6
100	0400-0001	Grommet, Rubber for 3/4 in. hole	1
101	0360-0064	Board, Terminal	1
102	2520-0002	Screw, Round head ss 8-32 thd, 3/8 in. lg	2
103	3050-0014	Washer, 3/8 in. od 0.26 in. id, bronze	4
104		NOT ASSIGNED	
105		NOT ASSIGNED	
106	00618-034	Plate, Guard	1
107	2360-0138	Screw, machine 6-32 x 1.75", pan head, Pozi	2

REF.	STOCK NO.	DESCRIPTION	QTY.
108		NOT ASSIGNED	
109	2190-0496	Washer, Flat Silicone Rubber; .85 ID, .975 OD, .06 thick	
110	2190-0006	Washer, Split lock for no. 6 screw	2
111	2390-0010	Screw, Bind. head ss, 6-32 thd, 1/2 in. lg	1
112	1400-0015	Clamp, Cable 1/4 in. dia cad pl s	2
113	2420-0002	Nut, 6-32 thd x 5/16 in. ss	5
114	5060-0016	Washer, no. 6, 9/32 in. od, nickel pl brass	1
115	2360-0205	Screw: Machine 6-32 x 0.75"	1
116	2360-0135	Screw, pan head, ss 6-32 x 1.5"	3
117	00618-2059	Tube, Atten	1
118	00618-2046	Board, Insulator	1
119	00618-60107	Board, Vlt. divider	1

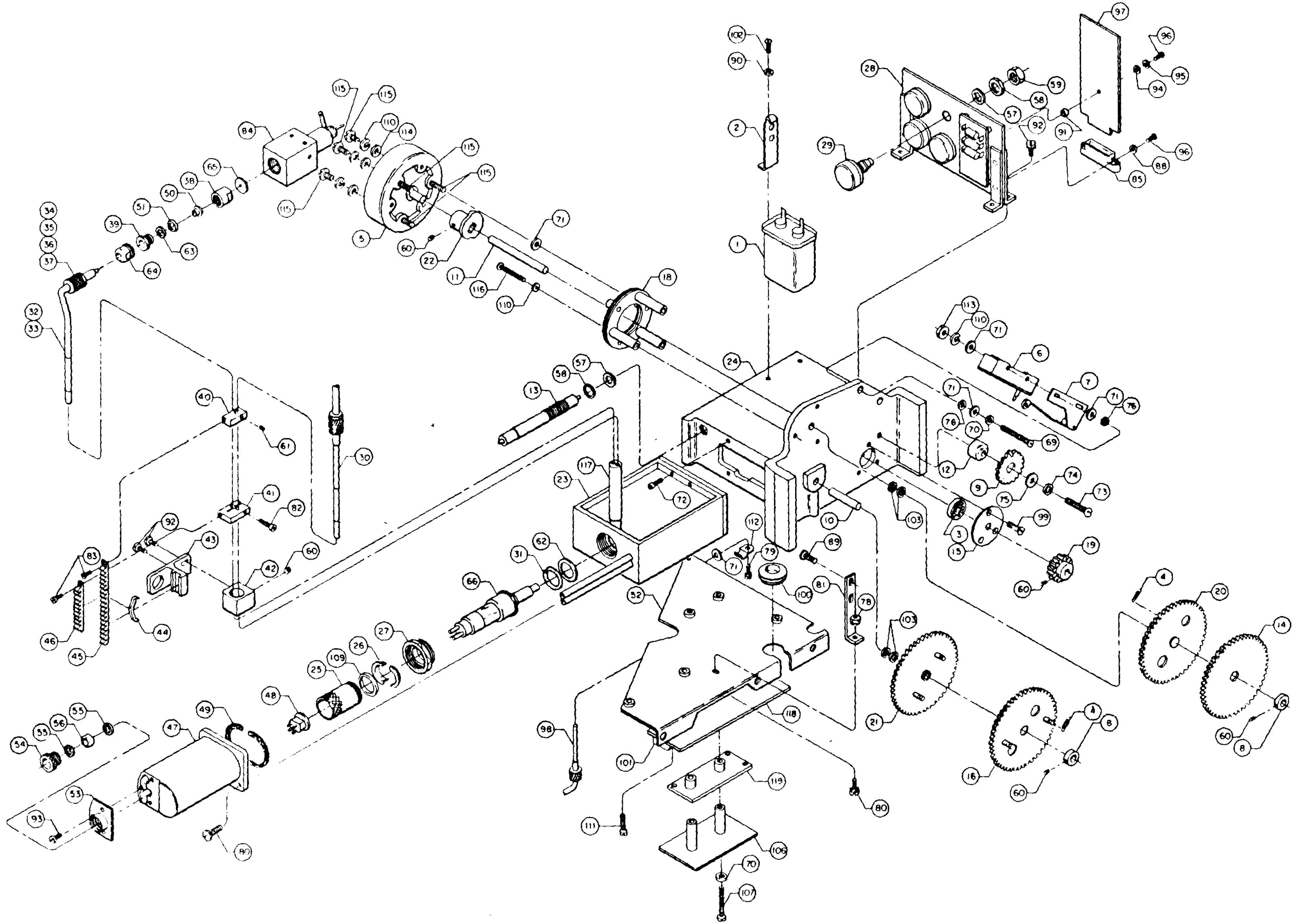


Figure I-5. HP Model 618C S.H.F. Signal Generator, Klystron Assembly and Drive Mechanism

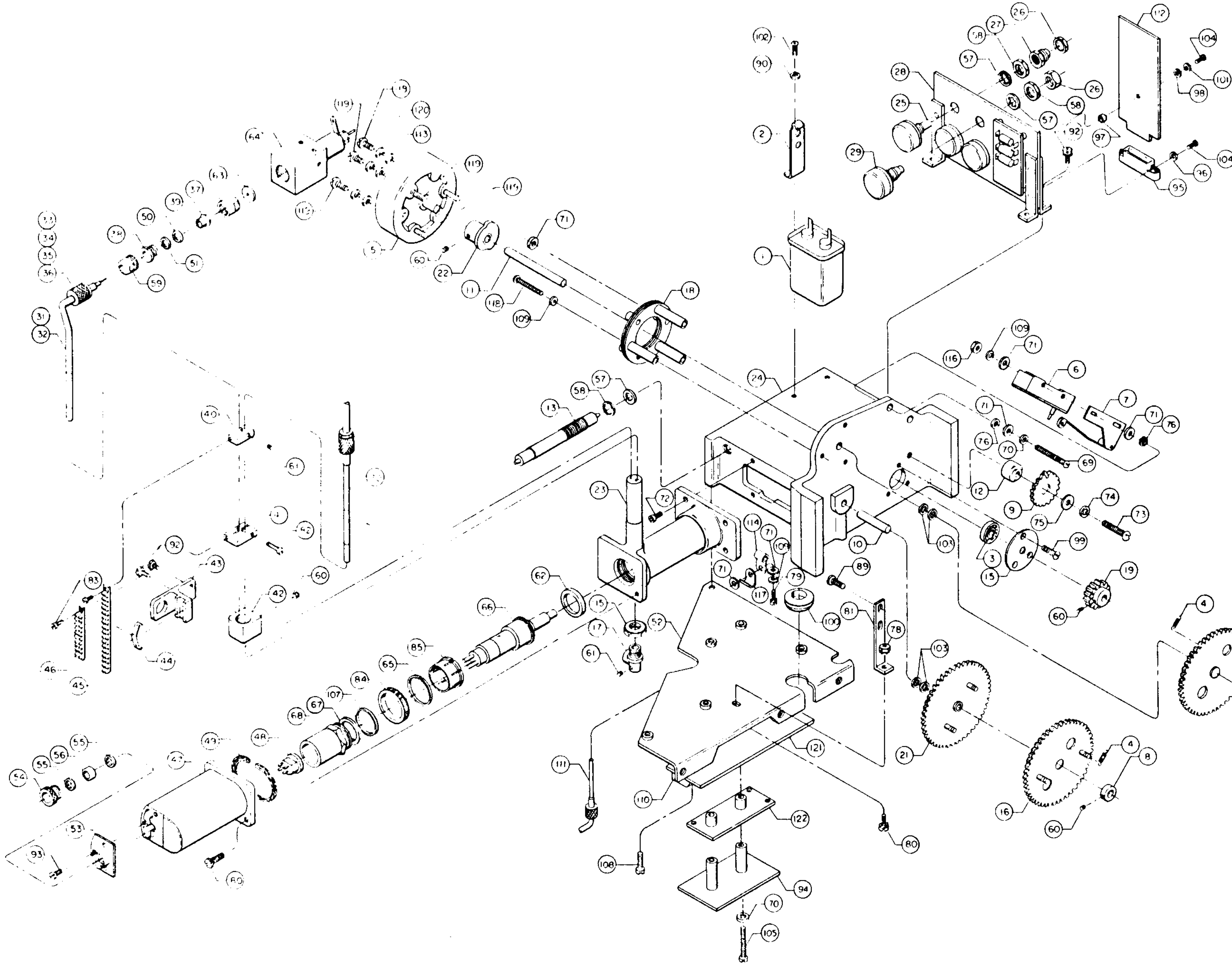


Figure I-6. HP Model 620B S.H.F. Signal Generator, Klystron Assembly and Drive Mechanism

Parts List for Figure I-6

REF.	STOCK NO.	DESCRIPTION	QTY.
1	0160-0088	Capacitor, Fxd paper 0.25 uf 10% 1.5K vdcw	1
2	1400-0525	Bracket, Mtg footed	2
3	1410-0009	Bearing, Ball .75 od .25 bore	2
4	1460-0048	Spring, Extension .688 lg	4
5	2100-0120	Resistor, Variable 100K ohms 5%, 8 w	1
6	3102-0001	Switch, SPDT	1
7	3102-0002	Lever, Switch actuator	1
8	5020-0233	Collar, 1/4 in. shaft 1/2 in. dia	2
9	5020-0277	Gear, Offset tooth	1
10	5020-0340	Shaft, 1/4 in. ss 1-5/16 in. long	1
11	5020-0349	Shaft, 2-3/4 in. long	1
12	608D-47J	Spacer, Stop gear	1
13	618B-27	Filter Assy	1
14	618B-35L	Gear, Idler	1
15	618B-36L	Retainer, Freq	2
16	618B-36Q	Gear, Freq	1
17	00620-224	Adapter	1
18	00618-20067	Pot Mounting Assy	1
19	618B-36AX	Gear, Freq drive	1
20	620A-36P	Gear, Pot drive	1
21	620A-36R	Gear, Freq	1
22	00620-242	Coupler, Potentiometer	1
23	00620-243	Cavity Assy	1
24	620A-36AA	Housing	1
25	2100-0045	Resistor, Variable 100K ohms, 10%, 1.12 w	1
26	0590-0035	Nut, for locking bush.	4
27	0590-0036	Bushing, Locking	1
28	00618-240	Board, Terminal	1
29	2100-0028	Resistor, Varil ible 50K	3
		ohms 10%, 2.25 w	1
30	620A-34BB	Attenuator Assy	1
31	620A-28N	Bolometer Plunger Assy	1

REF.	STOCK NO.	DESCRIPTION	QTY.
32	620A-34D	Sleeve, Dielectric	1
33	1250-0005	Nut, Connector	1
34	1250-0006	Washer, Connector	1
35	1250-0007	Gasket, Connector	1
36	1250-0008	Clamp, Connector	1
37	1250-0141	Clamping Body, RF connector	1
38	1250-0142	Nut, Clamp	1
39	1250-0143	Washer, Shouldered	1
40	620A-34A -1	Stop, Attenuator	1
41	620A-28C	Stop, Plunger	1
42	618B-3A	Clamp, Guide	1
43	618B-35B	Guide, Rack	1
44	620A-91A	Spring, Rack load	1
45	618B-35P -L	Gear, Rack	1
46	618B-35P -S	Gear, Rack	1
47	00618-6070	Socket Assembly	1
48	1200-0014	Socket, 4 Pin tube ring mounting	1
49	8160-0008	Braid, RF .25 dia aluminum	6"
50	1250-0145	Gasket	1
51	1250-0146	Washer, Flat	1
52	00618-00078	Bracket	1
53	618B-52B	Cover, Housing	1
54	5020-0621	Nut, 11/32 in. gland 9/16 in. dia	1
55	3050-0022	Washer, 7/16 in. od 5/16 in. id brass	2
56	0890-0002	Rubber, Tubing	1/4"
57	2190-0016	Washer, Int lock 1/2 in. od	5
58	2950-0001	Nut, 1/2 in. wide 3/8-32 thd, br	5
59	1250-0147	Nut, Retainer	1
60	3030-0001	Screw, Allen dr set 8-32 thd, 3/16 in. lg	13

REF.	STOCK NO.	DESCRIPTION	QTY.
61	3030-0007	Screw, Allen dr set 4-40 thd, 1/8 in. lg	2
62	618B-88A	Ring, Seating	1
63	1250-0148	Washer, Insulating	1
64	00618-628	Bolometer Detector Assy	1
65	0510-0779	Ring, Lock	1
66	1950-0017	Tube, Klystron	1
67	620A-90D	Ring, Washer Telfon	1
68	620A-90C	Nut, Tube collet	1
69	2360-0018	Screw, Round head ss 6-32 thd, 1-1/2 in. lg	5
70	2190-0007	Washer, Int lock for no. 6 screw	7
71	3050-0066	Washer, 3/8 in. od 0.147 in. id, brass	20
72	3030-0064	Screw, Cap sh 6-32 x .625	4
73	2680-0246	Screw, Hex Head ss 10-24 Thd, 7/8 in. lg.	1
74	2190-0011	Washer, Int lock for no. 10 screw	1
75	3050-0019	Washer, Flat brass 1/2 in. od	1
76	3050-0005	Washer, 3/8 in. od for no. 6 screw fiber	4
77		NOT ASSIGNED	
78	2580-0003	Nut, 11/32 in. wide 8-32 thd, w/lock	1
79	2390-0010	Screw, Bind. head ss 6-32 thd, 1/2 in. lg	1
80	2550-0009	Screw, Bind. head ss 8-32 thd, 1/2 in. lg	5
81	618B-47A	Support, Bracket	1
82	3030-0016	Screw, Allen dr cap 6-32 thd, 1/2 in. lg	1
83	0520-0004	Screw, Mach brs 2-56 x 3/16 fil hd sd ni-p	2
84	00620-201	Ring, Collet	1

Parts List for Figure I-6 (Cont'd)

REF.	STOCK NO.	DESCRIPTION	QTY.
85	00620-200	Collet, Tube	1
86		NOT ASSIGNED	
87		NOT ASSIGNED	
88		NOT ASSIGNED	
89	2550-0007	Screw. Bind. head ss, 8-32 thd, 3/8 in. lg	6
90	2190-0009	Washer, Int lock for no. 8 screw	2
91		NOT ASSIGNED	4
92	2390-0009	Screw, Bind. head ss, 6-32 thd, 3/8 in. lg	6
93	2220-0003	Screw, Fil head ss. 4-40 thd, 5/16 in. lg	3
94	00618-034	Plate, Guard	1
95	1251-0234	Connector, P.C. board 6 pin	1
96	2190-0004	Washer, Int lock for no. 4 screw	2
97	0380-0003	Spacer, 1/4 in. od, 1/8 in. lg	1
98	3050-0229	Washer, 0.250 in. od, 0.117 in. id, ss,	1
99	2370-0003	Screw, Flat head ss, 6-32 thd, 1/2 in. lg	6
100	0400-0001	Grommet, Rubber for 3/4 in. hole	1
101	2190-0061	Washer, Split lock for no. 4 screw	1
102	2520-0002	Screw, Round head ss, 8-32 thd, 3/8 in. lg	2
103	3050-0014	Washer, 3/8 in. od, 0.26 in. id, bronze	4
104	2200-0006	Screw, Round head ss, 4-40 thd, 3/8 in. lg	3
105	2360-0138	Screw Machine 6-32 x 1.75" pan head, Pozi	2
106		NOT ASSIGNED	
107	2190-0496	Washer, Flat Silicone Rubber; .85 ID, .975 OD, .06 thick	1
108	2390-0010	Screw, Bind, head ss, 6-32 thd, 1/2 in. lg	2
109	2190-0006	Washer, Split lock for no. 6 screw	8
110	0360-0064	Board, Terminal	1
111	00620-624	Sample Probe Assy	1
112	00618-632	Board Assy, Bolometer amplifier	1
113	3050-0016	Washer, no. 6, 9/32 in. od, nickel pl brass	5
114	1400-0016	Clamp, Cable 9/16 in. dia nylon	1
115	2950-0002	Nut, 7/16-20 thd, nickel pl brass	1
116	2420-0002	Nut, 6-32 thd x 5/16 in. ss	2
117	1400-0015	Clamp, Cable 1/4 in. dia cad pl s	1
118	2360-0135	Screw, pan head 6-32 x 1.5, ss.	3
119	2360-0205	Screw, machine, 6-32 x 0.75	1
120	2190-0018	Washer, split lock, No. 6	3
121	00618-2046	Board, insulator	1
122	00618-60107	Board, Vlt. divider	1

Parts List for Figure I-7

REF.	STOCK NO.	DESCRIPTION	QTY.
1	620A-36AA	Housing	1
2	00618-204	Drive Screw and Nut	1
3	618B-36D	Guide, Frequency	2
4	618B-36F	Spacer, Rod	6
5	618B-36L	Retainer, Frequency	2
6	618B-36AD	Bar, Stop	1
7	618B-36AE	Spacer, Stop	3
8	618B-36E	Rod, Connecting	4
9	618B-36G	Bar, Plunger	1
10	618B-36AJ	Pin, Link	2
11	620A-36BB	Plate, Cover	1
12	00618-2061	Cavity Assy	1
13	1410-0009	Bearing, Ball .75 od .25 bore	2
14	1460-0041	Spring, Extension 1.875 in. lg	2
15	2390-0007	Screw, Bind. head ss 6-32 thd, 5/16 in. lg	11
16	3050-0066	Washer, 3/8 in. od 0.147 in. id, brass	8
17	3050-0014	Washer, 3/8 in. od 0.26 in. id, bronze	4
18	2680-0176	Screw, Hex head ss	2
19	2190-0034	Washer	2
21	0360-0036	Terminal, Lug, brass angle type	4
22	2370-0003	Screw, Flat head ss 6-32 thd, 1/2 in. lg	6
23	1400-0015	Clamp, Cable 1/4 in. dia, steel	1
24	2360-0011	Screw, Round head ss 6-32 thd, 3/4 in. lg	3
25	2390-0009	Screw, Bind. head ss 6-32 thd, 3/8 in. lg	4
26	2190-0007	Washer, Int lock for no. 6 screw	3
27	8160-0008	Braid, RF .25 dia aluminum	1
28	3030-0001	Screw, Allen dr set 8-32 thd, 3/16 in. lg	2
29	618B-36Z	Conductor, Center	1
30	618B-36AA	Plate, Back	1
31	618B-36AK	Filter, Repeller assy	1
32	618B-36BC	Plunger Assy	1
33	618B-36Y	Ring, Teflon insert	1

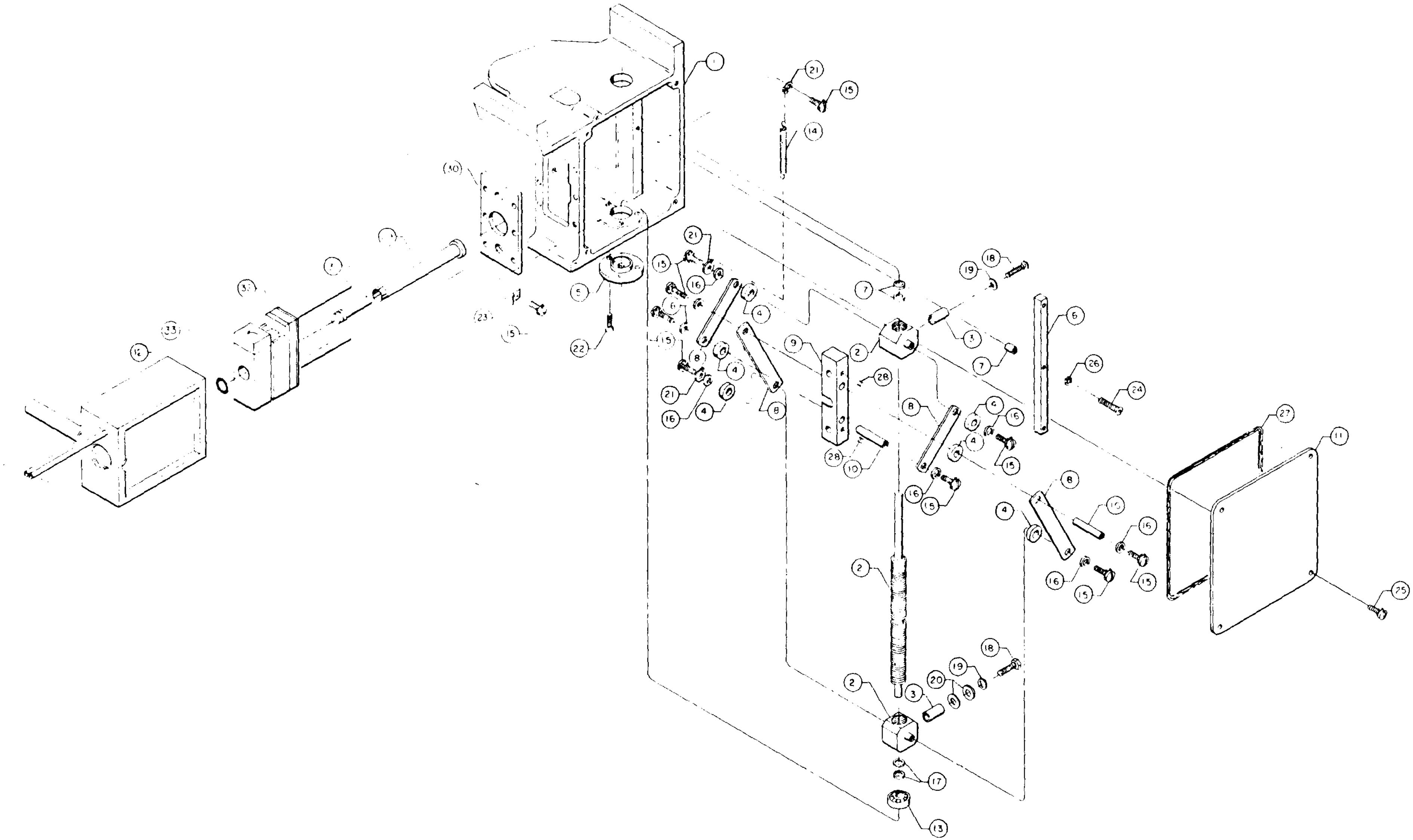


Figure I-7. HP Model 618C S.H.F. Signal Generator, Frequency Drive Mechanism

Parts List for Figure I-8

REF.	STOCK NO.	DESCRIPTION	QTY.
1	620A-36AA	Housing	1
2	00618-204	Drive Screw and Nut	1
3	618B-36D	Guide, Frequency	2
4	618B-36F	Spacer, Rod	4
5	618B-36L	Retainer, Frequency	2
6	618B-36AD	Bar, Stop	1
7	618B-36AE	Spacer, Stop	3
8	620A-36C	Rod, Connecting	4
9	620A-36D	Bar, Plunger	1
10	620A-36F	Pin, Plunger	2
11	620A-36G	Plate, Drive	1
12	00620-20049	Conductor, Center	1
13	620A-36J	Plunger Assy	1
14	620A-36L	Pin, Link	1
15	620A-36BB	Plate, Cover	1
16	1410-0009	Bearing, Ball .75 od .25 bore	2
17	00620-243	Cavity Assy	1
18	1460-0041	Spring, Extension 1.875 lg	2
19	2220-0005	Screw, Fil head ss, 4-40 thd, 5/8 in. lg	2
20	2390-0007	Screw, Bind. head ss, 6-32 thd, 5/16 in. lg	9
21	3050-0066	Washer, 3/8 in. od 0.147 in. id, brass	6
22	3030-0030	Screw, Allen dr cap 6-32 thd, 1 in. lg	1
23	3050-0014	Washer, 3/8 in. od 0.26 in. id, bronze	4
24	00620-0176	Screw, Hex head ss, 10-24 thd, 3/4 in. lg	2
25	2190-0034	Washer	2
27	0360-0036	Terminal lug brass angle type	4
28	2370-0003	Screw, Flat head ss, 6-32 thd, 1/2 in. lg	6
29	1400-0054	Clamp, Cable 1/8 in. dia, steel	1
30	3030-0007	Screw, Allen dr set 4-40 thd, 1/8 in. lg	4
31	2360-0011	Screw, Round head ss, 6-32 thd, 3/4 in. lg	3
32	2390-0009	Screw, Bind. head ss, 6-32 thd, 3/8 in. lg	4
33	2190-0007	Washer, Int lock for no. 6 screw	3
34	8160-0008	Braid, RF .25 dia aluminum	1
35	620A-36M	Filter, Repeller	1

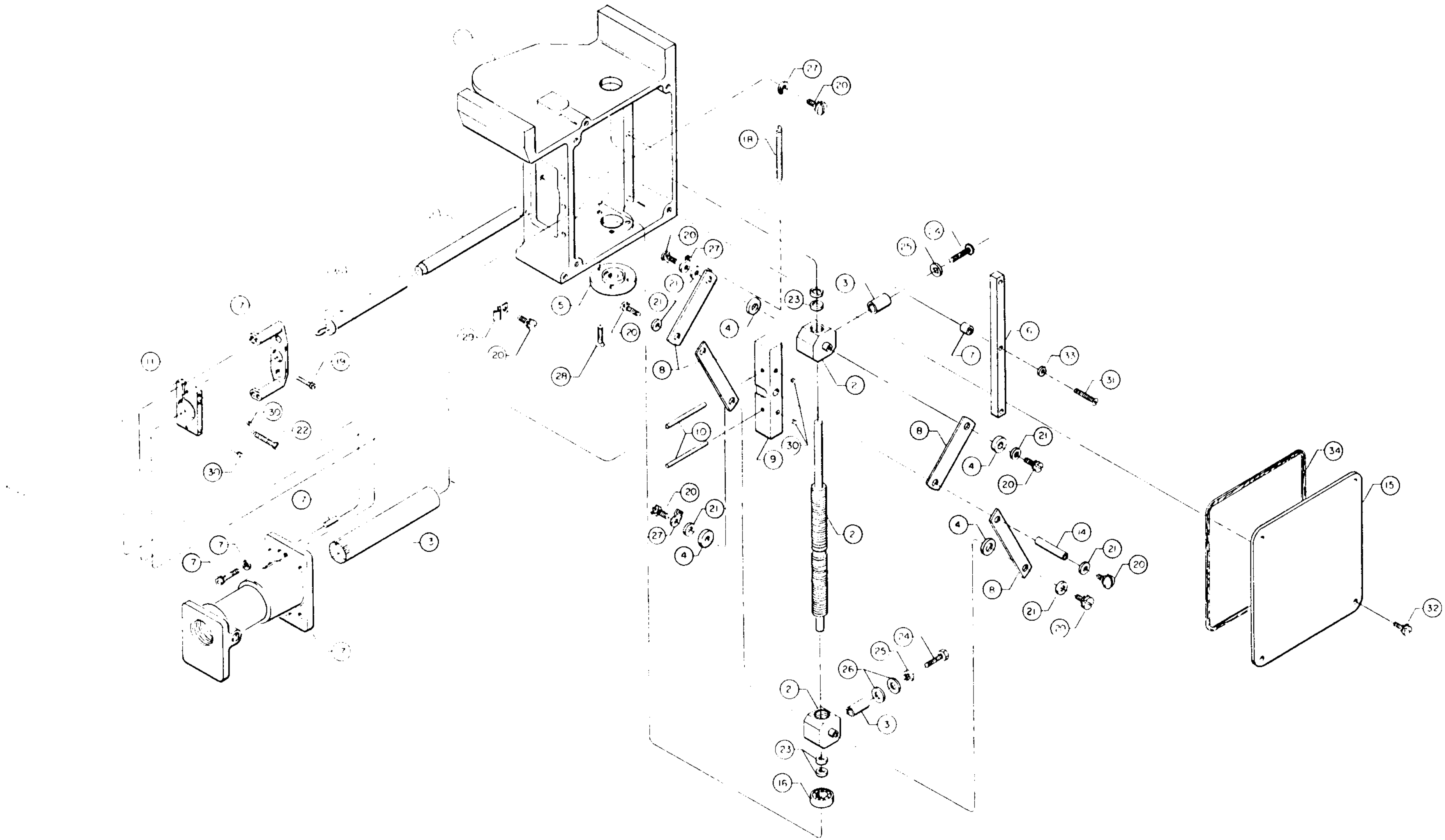


Figure I-8. HP Model 620B S. H. F. Signal Generator, Frequency Drive Mechanism

Parts List for Figure I-9

REF.	STOCK NO.	DESCRIPTION	QTY.
1		See Figure 10	
2		See Figure 11	
3		See Figure 12	

REF.	STOCK NO.	DESCRIPTION	QTY.

REF.	STOCK NO.	DESCRIPTION	QTY.

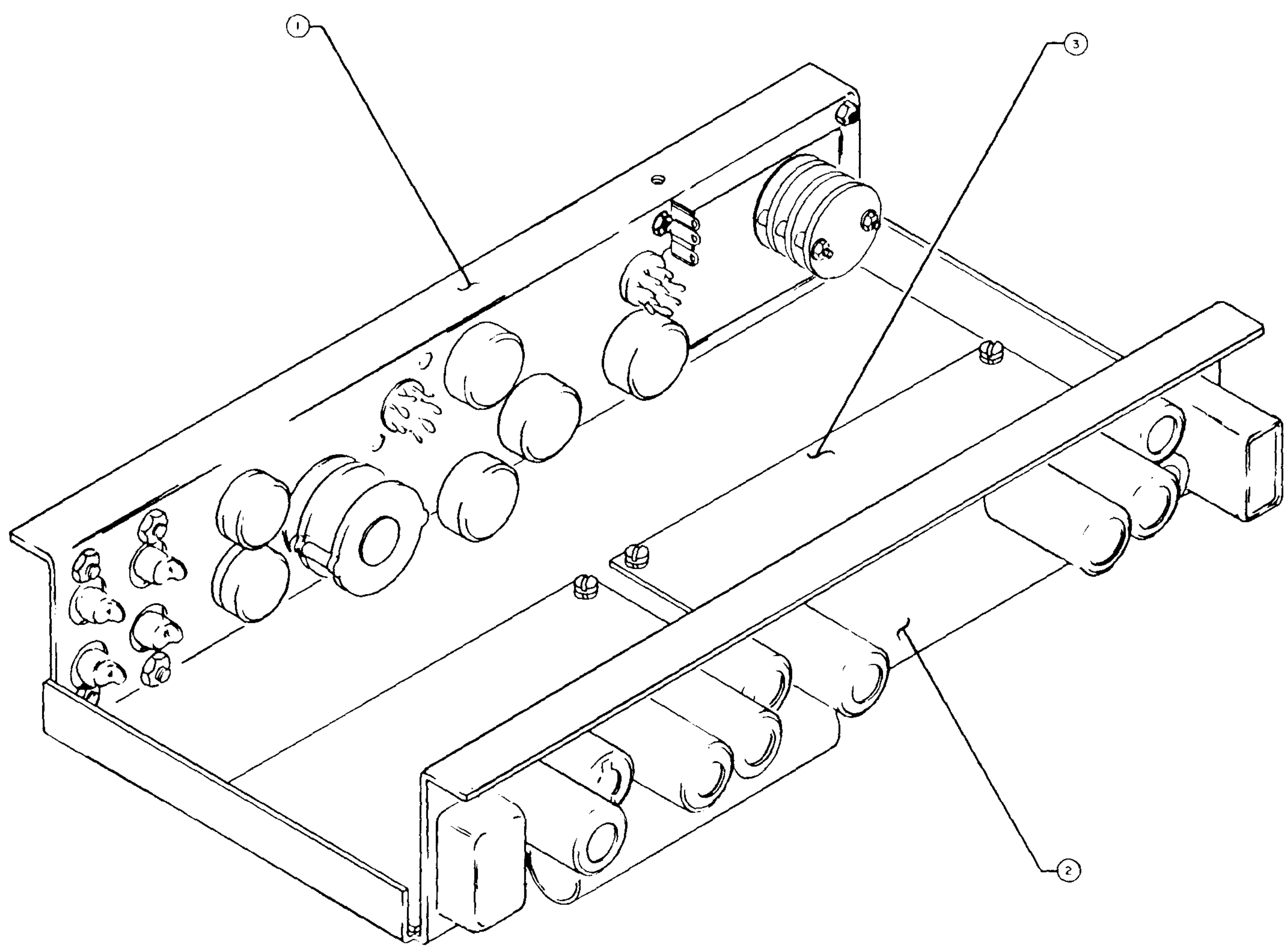


Figure I-9. HP Model 618C/620B S.H.F. Signal Generator, Pulser Section Index

Parts List for Figure I-10

REF.	STOCK NO.	DESCRIPTION	QTY.
1	2950-0001	Nut, 1/2 in. wide 3/8-32 thd, br	8
2	2190-0006	Washer, Split lock for no. 6 screw	5
3	3050-0066	Washer, 3/8 in. od 0.147 in. id, brass	5
4	2190-0022	Washer, Int. lock 11/16 in. od	8
5	3100-0076	Switch, Rotary 4 sect, 8 pos	1
6	00618-0055	Plate, switch	1
7	1200-0003	Socket, 9 pin tube	2
8	3100-0075	Switch Rotary 2 sect, 5 pos	1
9	2390-0010	Screw, B.H. ss 6-32 x .5	4
10	2420-0001	Nut, 5/16 in. wide ss 6-32 thd, w/lock	9
11	2100-0025	Resistor, Variable 1.5K ohms, 10%, 2.25 w	1
12	2100-0059	Resistor, Variable 3 x 1 meg ohms 10% 2 w	1
13	2100-0051	Resistor, Variable 20K ohms, 10%, 1.12 w	1
14	2100-0047	Resistor, Variable 1 meg ohm 20% 1.12 w	1
15	2100-0029	Resistor, Variable 250K ohms, 10%, 2.25 w	2
16	2190-0008	Washer, Ext lock for no. 6 screw	5
17	0160-0081	Capacitor, Fxd paper 0.25 uf 10% 1K vdcw	2
18	2390-0009	Screw, Bind. head ss, 6-32 thd, 3/8 in. lg	5
19	2950-0033	Nut, 1/2 in. wide, 3/8-32 thd, br	3
20	5020-0238	Head, Coupler 3/4 in. dia	4
21	3030-0001	Screw, Allen dr set 8-32 thd, 3/16 in. lg	10
22	1932-0046	Tube, Electron 12AU7	2
23	1220-0009	Shield, Tube 9 pin 1-15/16 in. h	2
24	618B-16S	Cable Assy	1
25	618B-52	Socket Assy	1
28	1400-0031	Clamp, Cable 3/8 in. dia nylon	1
29	0360-0015	Strip, 3 terminal 2 ins 1 gnd	1
31	5040-0224	Head, Coupler	1
36	0360-0031	Lug, Terminal for no. 6 screw	1

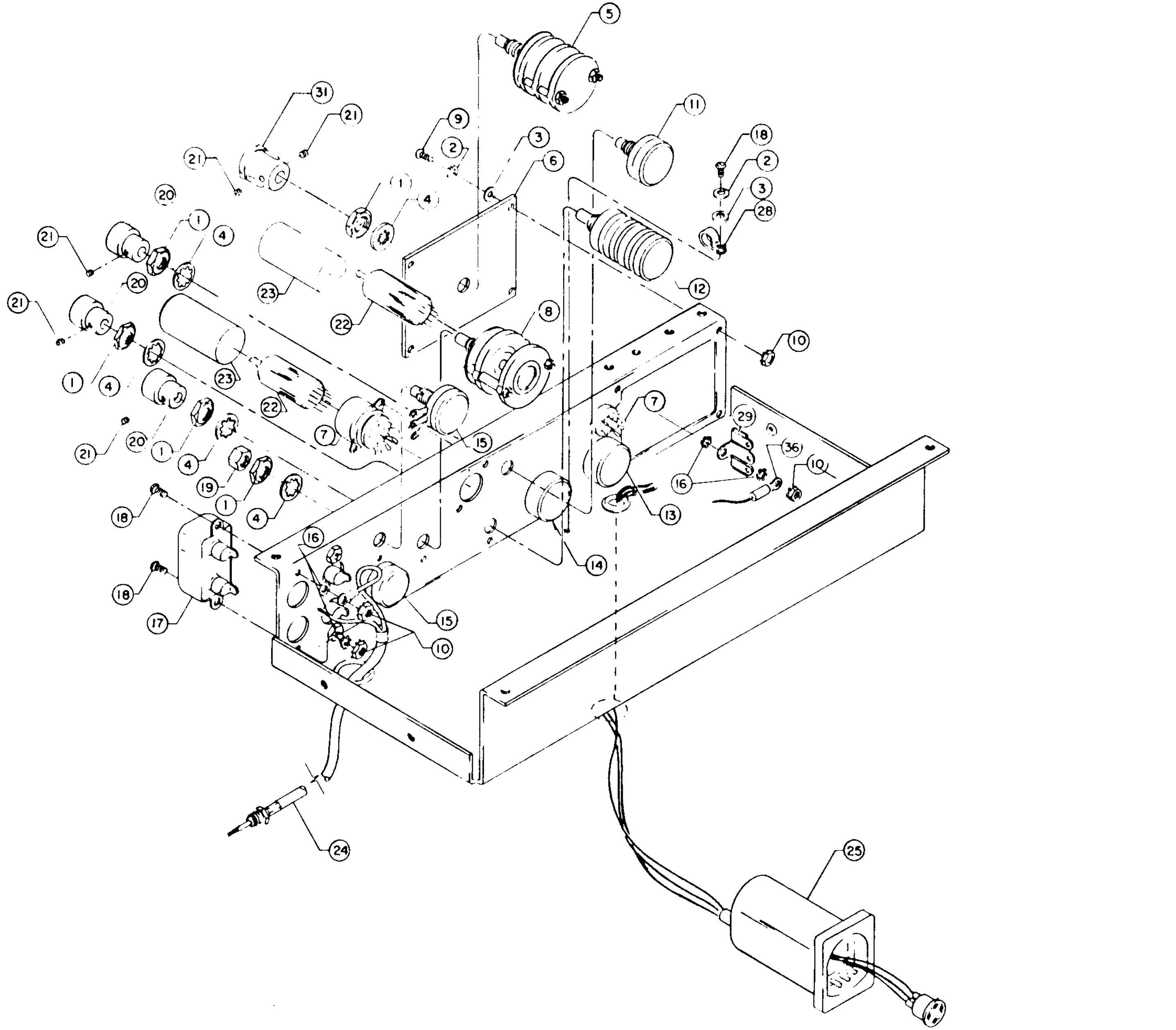


Figure I-10. HP Model 618C/620B S.H.F. Signal Generator, Partial Rear View, Pulser Section

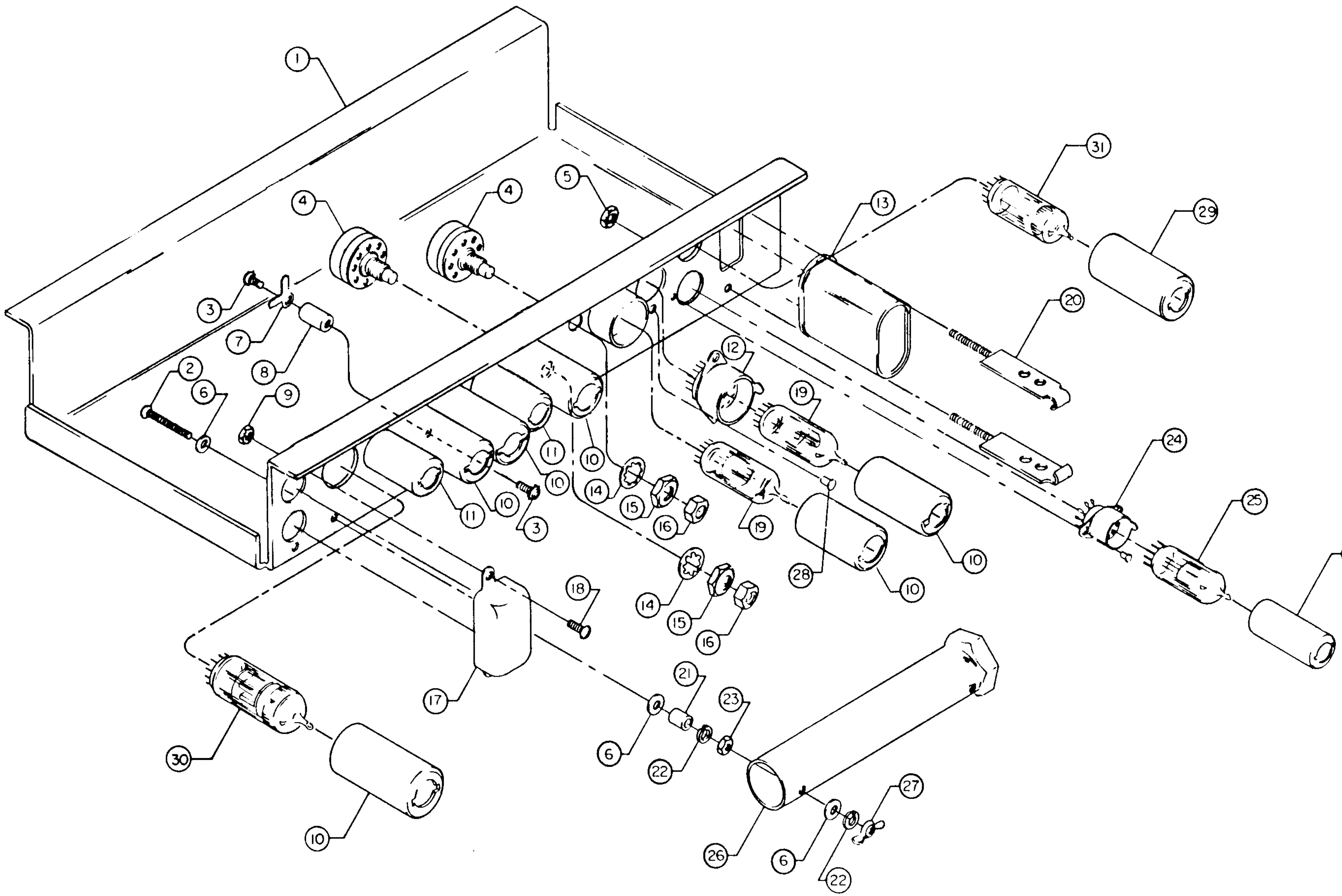


Figure I-11. HP Model 618C/620B S.H.F. Signal Generator, Partial Rear View, Pulser Section

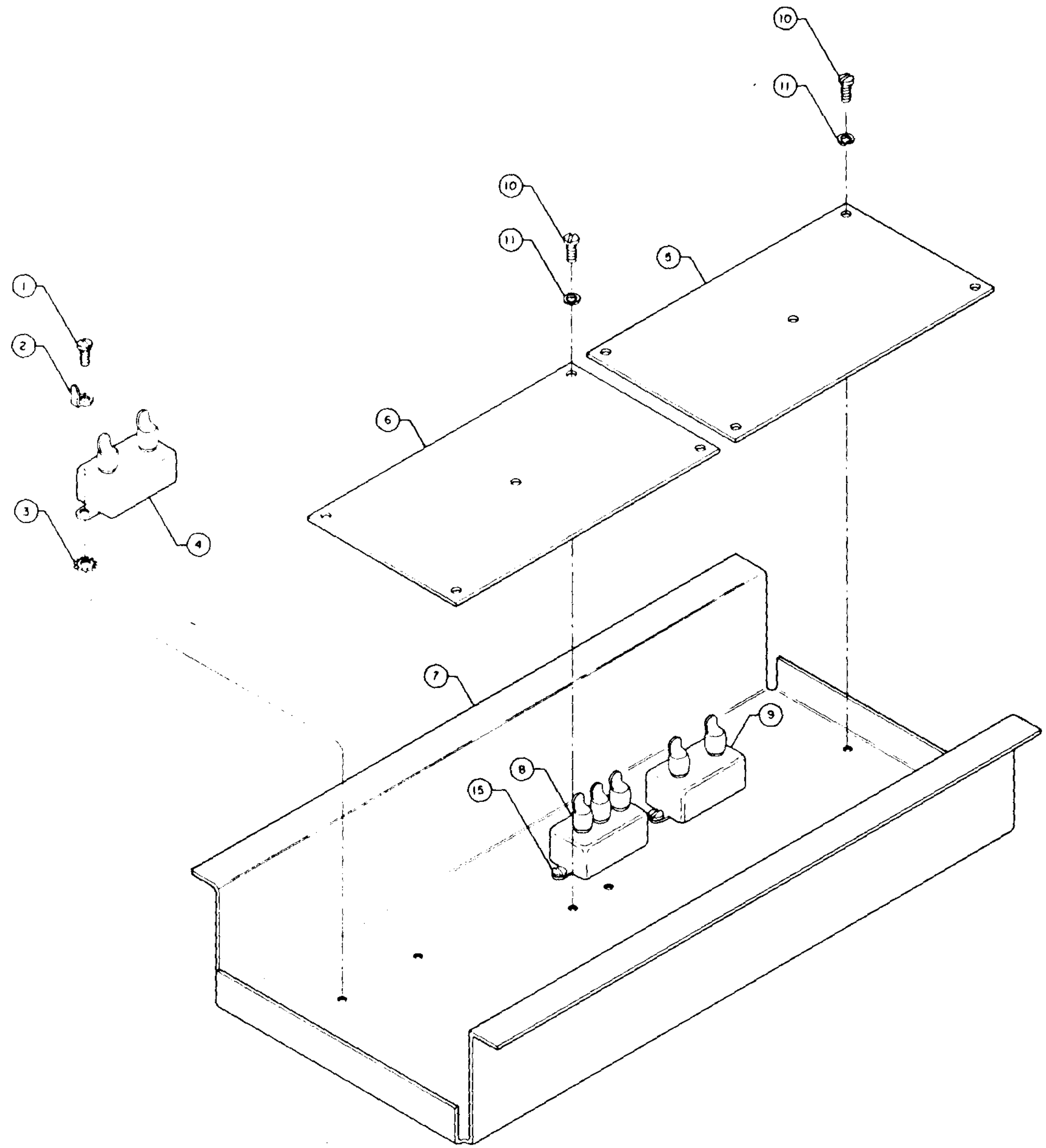


Figure I-12. HP Model 618C/620B S.H.F. Signal Generator, Partial Rear View, Pulser Section

Parts List for Figure I-13

REF.	STOCK NO.	DESCRIPTION	QTY.
1	0160-0102	Capacitor, Fxd paper 4 uf 10% 1K vdcw	3
2	0180-0128	Capacitor, Fxd electrolytic 2800 uf 30 vdcw	1
3	0180-0024	Capacitor, Fxd electrolytic 40 uf 450 vdcw	5
4	00618-022	Chassis, Power	1

REF.	STOCK NO.	DESCRIPTION	QTY.

REF.	STOCK NO.	DESCRIPTION	QTY.

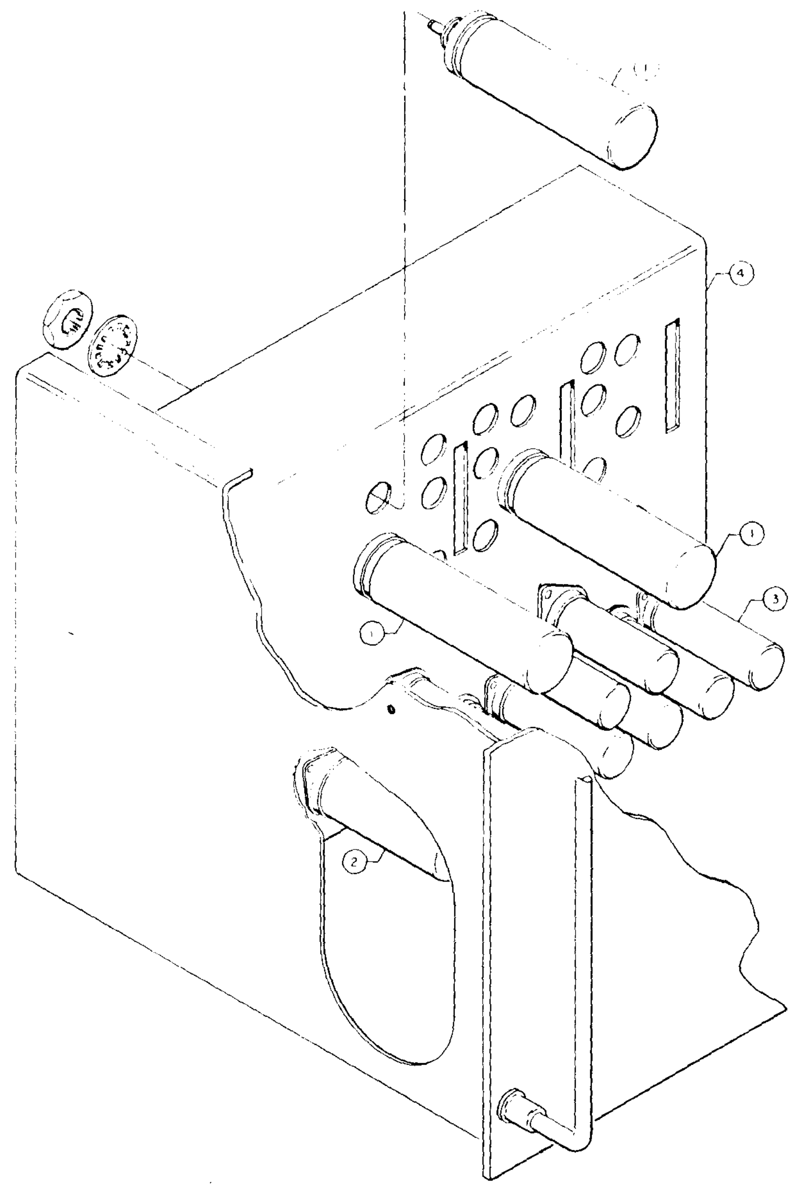


Figure I-13. HP Model 618C/620B S.H.F. Signal Generator, Chassis, Front View

Parts List for Figure I-14

REF.	STOCK NO.	DESCRIPTION	QTY.
1	00618-6060	Board Assy, -300 VPS	1
2	00618-6061	Board Assy, -1000 VPS	1
3	00618 6062	Board Assy, - 1550 VPS	1
4	9100-1703	Transformer, Power	1
5	2940-0005	Screw, Truss head ss, 1/4-20 thd, 3/4 in. lg	4
6	2190-0032	Washer, Split lock for 1/4-20 screw	4
7	2950-0004	Nut, 7/16 in. wide, 1/4-20 thd ss	4
8	00618-030	Bracket, Transformer support	1
9	2990-0002	Screw, Truss head ss, 10-24 thd, 1/2 in. lg	31
10	2980-0002	Nut, 3/8 in. wide, 10-24 thd, w/lock	10
			1
12	2550-0007	Screw, Bind. head ss, 8-32 thd, 3/8 in. lg w/lock	1
13	2190-0010	Washer, Ext lock for no. 8 screw, .851 in. od	1
14	2580-0003	Nut, 11/32 in. wide, 8-32 thd, w/ext lock	1
15	2520-0019	Screw, Round head ss, 8-32 thd, 4-1/2 in. lg	1
			1
17	2580-0003	Nut, 11/32 in. wide, 8-32 thd, w/ext lock	1
			1
			1
20	2360-0011	Screw, Round head ss, 6-32 thd, 3/4 in. lg	2
21	2190-0006	Washer, Split lock for no. 6 screw	2
22	3050-0016	Washer, no. 6, 9/32 in. od, brass	2
23	2420-0003	Nut, 1/4 in. wide, 6-32 thd	2
24	9100-2887	Filter, Line	1
25	2550-0007	Screw, Bind. head ss, 8-32 thd, 3/8 in. lg w/ext lock	2
26	2580-0003	Nut, 11/32 in. wide, 8-32 thd, w/lock	2
27	0360-0015	Strip, 3 terminal, 2 ins, 1 gnd	1
28	2270-0001	Screw, Bind. head ss, 6-32 thd, 5/16 in. lg	1
29	2190-0004	Washer, Int lock for no. 4 screw	2
30	2260-0002	Nut, 3/16 in. wide, 4-40 thd	1
31	2110-0003	Fuse, Cartridge 3.0 amp	1
	2110-0338	Fuse, Cartridge 1.6 amp	1
32	1400-0084	Fuseholder, Post type 2-5/64 in. lg	1
33	1251-1036	Connector, 7 contact female	1
34	00618-00070	Bracket, Fan	1
35	2190-0034	Washer, Split lock for no. 10 screw	21
36	1251-2357	Connector, 3 contact ac power receptacle	1
37	3101-1234	Switch, Slide DPDT	1
38	618B-12D	Bracket, Cabinet	2
39	618B-12E	Bracket, Cabinet	2
40	00618-0056	Gusset, Extension	2
41	5040-0601	Guide, Circuit board 2-1/2 in. lg	6
42	00618-0050	Deck, Voltage Regulator	1
43	3050-0226	Washer, 0.438 in. od, 0.195 in. id, ss	4
44	1251-1037	Connector, 7 contact male cable plug	1
45	1251-1039	Ring, Lock	1
46	1251-1040	Spring, Lock	1
47	1251-1041	Hood, Insulating	1
48	1251-0194	Connector, 15 contact printed circuit type	3
53	00618-031	Gusset, Right	1
54	00618-0053	Gusset, Left	1
55	2520-0017	Screw, Round head ss, 6-32 thd, 2-3/4 in. lg	1
56	3050-0071	Washer, no. 8, 7/16 in. od, cad pl brass	2
57	3050-0006	Washer, no. 10, 1/2 in. od, fibre	2
58	2190-0017	Washer, Split lock for no. 8 screw	1
59	2580-0004	Nut, 8-32 thd x 11/32 in. ss	1
60	3050-0019	Washer, no. 10, 1/2 in. od, nickel pl brass	4
61	2980-0001	Nut, 10-24 thd x 3/8 in. ss	4
62	2950-0038	Nut, 1/2-24 thd x 11/16 in., cad pl s	2
63	2190-0037	Washer, Int lock for 1/2 in. screw	2
64	0900-0016	O-ring, Rubber 1/2 in. id, 11/16 in. od	1

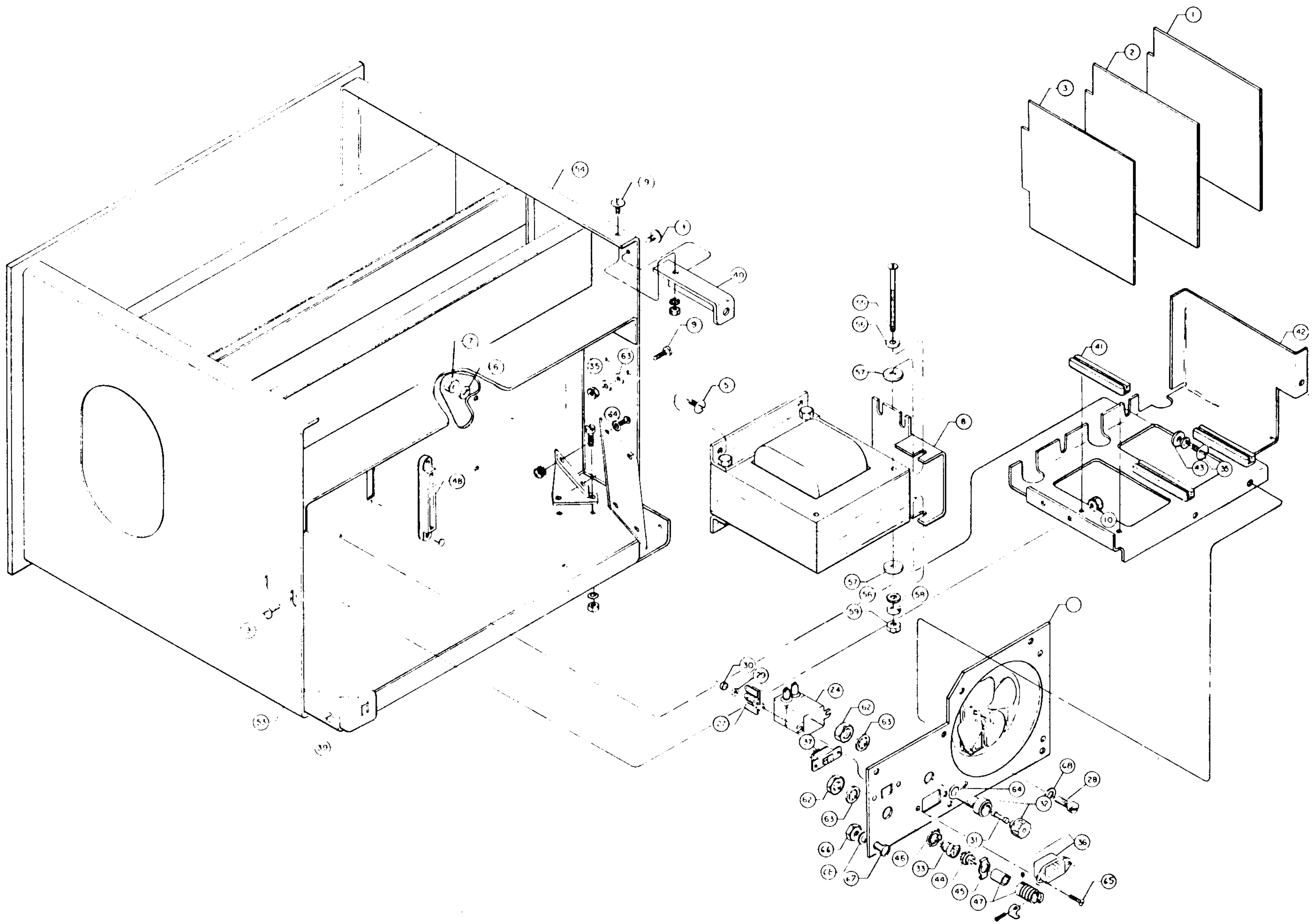


Figure I-14. HP Model 618C/620B S.H.F. Signal Generator, Chassis, Rear View

Parts List for Figure I-15

REF.	STOCK NO.	DESCRIPTION	QTY.
1	00618-60099	Cabinet Assembly	1
	00618-6063	Cabinet Assembly. Rack	1
2	5020-7433	Captive Screw Assy (Cabinet Model only)	4
3	3150-0005	Filter. Air	1
4	2940-0039	Screw. Pozidrive (Not shown. Rack Models only.)	4

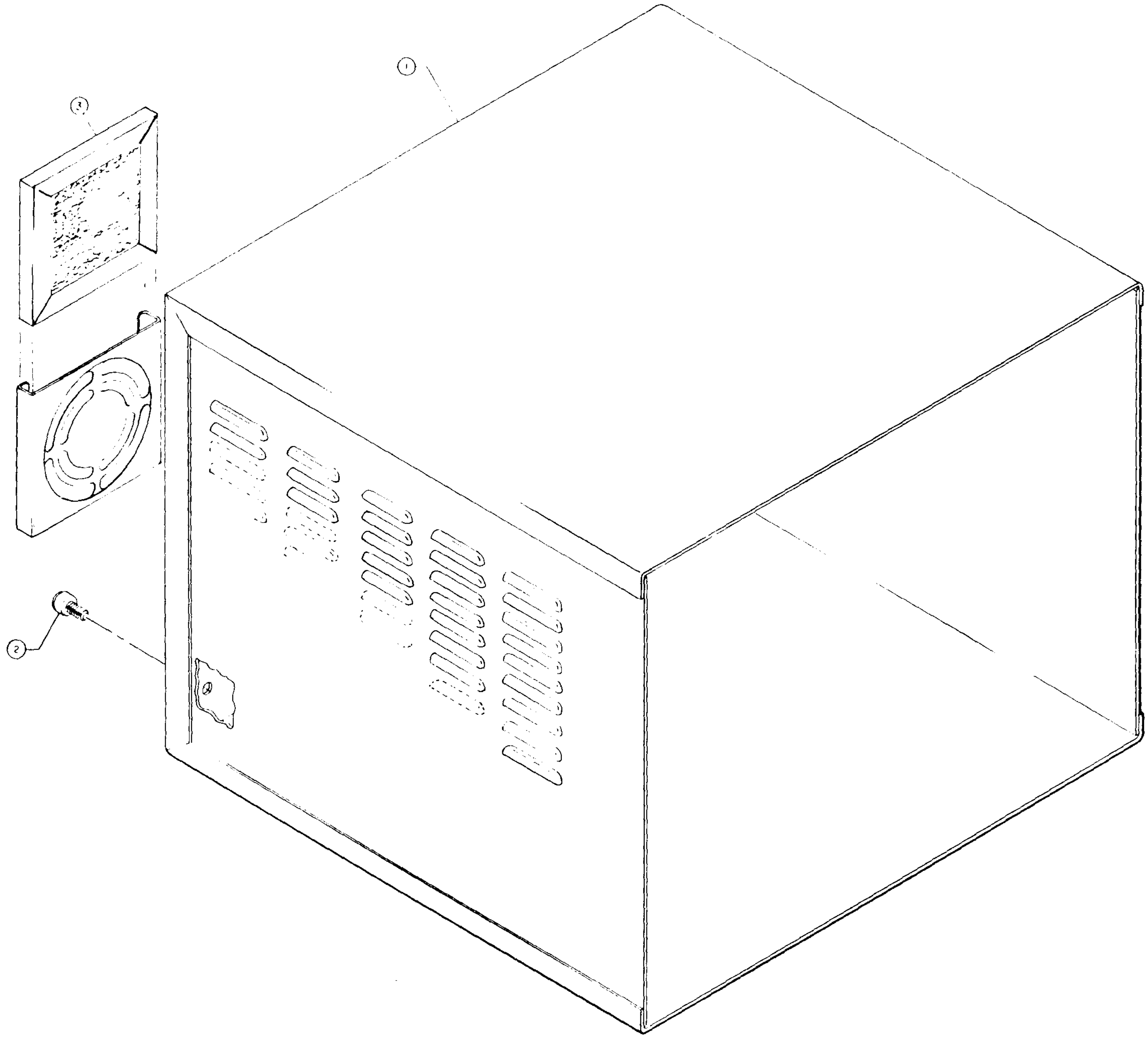


Figure I-15. HP Model 618C/620B S.H.F. Signal Generator, Dust Cover

APPENDIX II

MANUAL CHANGES

INTRODUCTION

This section contains information for adapting this manual to instruments for which the content does not apply directly. In addition, information about recommended modifications for improvements to the instrument is provided.

MANUAL CHANGES

To adapt this manual to your instrument, refer to Table II-1 (618C) or Table II-2 (620B) and make all of the manual changes listed opposite your instrument serial number or prefix. Perform these changes in reverse-alphabetical order (for example, change C, then B, then A).

If your instrument serial number or prefix is not listed on the title page of this manual, or in Tables II-1 or II-2, it may be documented in a yellow MANUAL CHANGES supplement. For additional information about serial number coverage refer to INSTRUMENT IDENTIFICATION in Section I of this manual.

INSTRUMENT IMPROVEMENT MODIFICATIONS

Some instrument modifications are recommended in this section (for example, for improved performance, reliability, or parts availability). These instrument modifications are not the same as manual changes that change this manual to apply directly to your instrument. Be aware also, that instrument modifications lessen the significance of the serial number perfix and nullify the need for corresponding manual changes.

Table II-1. 618C Manual Changes By Serial Number

Serial Prefix or Number	Make Manual Changes
630-	A—T,V
645-00176 to 645-00200	B—T,V
702-00201 to 702-00210	C—T,V
702-00211 to 702-00278	D—T,V
716-	E—T,V
740-00701 to 740-00725	F—T,V
740-00726 to 740-01250	G—T,V
915-	H—T,V
934-01376 to 934-01500	I—T,V
934-01501 to 934-01525	J—T,V
963-	K—T,V
979-, and 0979A to 01765	L—T,V
0979A01766 and above	M—T,V
1133A	N—T,V
1201A	O—T,V
1228A01991 to 02080	P—T,V
1228A02081 to 02110	Q—T,V
1311A	R—T,V
1441A, 1448A	S,T,V
1518A	T,V
1546A	V

Table II-2. 620B Manual Changes By Serial Number

Serial Prefix or Number	Make Manual Changes
633-	A—V
645-00151 to 645-00175*	B—V
645-00176 to 645-00200**	D—V
718-	E—V
740-	G—V
911-	H—V
935-01151 to 935-01225	I—V
935-01226 to 935-01250	J—V
963-	K—V
985-, and 0985A	L—V
1134A	M—V
1201A	O—V
1231A01786 to 01860	P—V
1231A01861 to 01890	Q—V
1312A	R—V
1443A, 1447A	S—V
1517A	T—V
1546A	V

*Excluding 645-00156, 645-00163, and 645-00165.

**Including 645-00156, 645-00163, and 645-00156

CHANGE A

Page 5-37/5-38, Figure 5-31:
Change R513 to 562K.

Page 6-4, Table 6-2:
Change R513 to 0757-0790 RESISTOR 562K 1% 0.25W F TC-0±100.

CHANGE B

Page 6-8, Table 6-2:
Change S1 to 3101-0107 SWITCH, PUSHBUTTON.

CHANGE C

Change CR401 and CR402 to 1901-0036 DIODE-HV RECT 1 KV 600 MA DO-29.

NOTE

The recommended replacement for CR401 and CR402, however, is diode 1901-0487 (not 1901-0036).

CHANGE D

Page 5-37/5-38, Figure 5-31:
Change R360 to 18 ohms.
Change R372 to 15K.

Page 6-3, Table 6-2:
Change R360 to 0693-1801 RESISTOR 18 OHMS 10% 2W CC TC=0+412.
Change R372 to 0693-1531 RESISTOR 15K 10% 2W CC TC=0+765.

CHANGE E

Page 5-37/5-38, Figure 5-31:
Change R374 to 1.21M.

Page 6-3, Table 6-2:
Change R374 to 0757-0871 RESISTOR 1.2M 1% 0.5W F TC=0±100.

CHANGE F

Page 5-31/5-32, Figure 5-28:
Delete asterisk (*) from R701 (not a factory selected part; the value shown is the acutal value).

CHANGE G

Page 6-4, Table 6-2:
Change the part numbers for A700 and A800 as shown below:

A700 (618C) 00618-6059
A700 (620B) 00620-6027
A800 (both) 00618-6058

CHANGE H

Page 5-26, Figure 5-23:
Replace figure with attached photo.

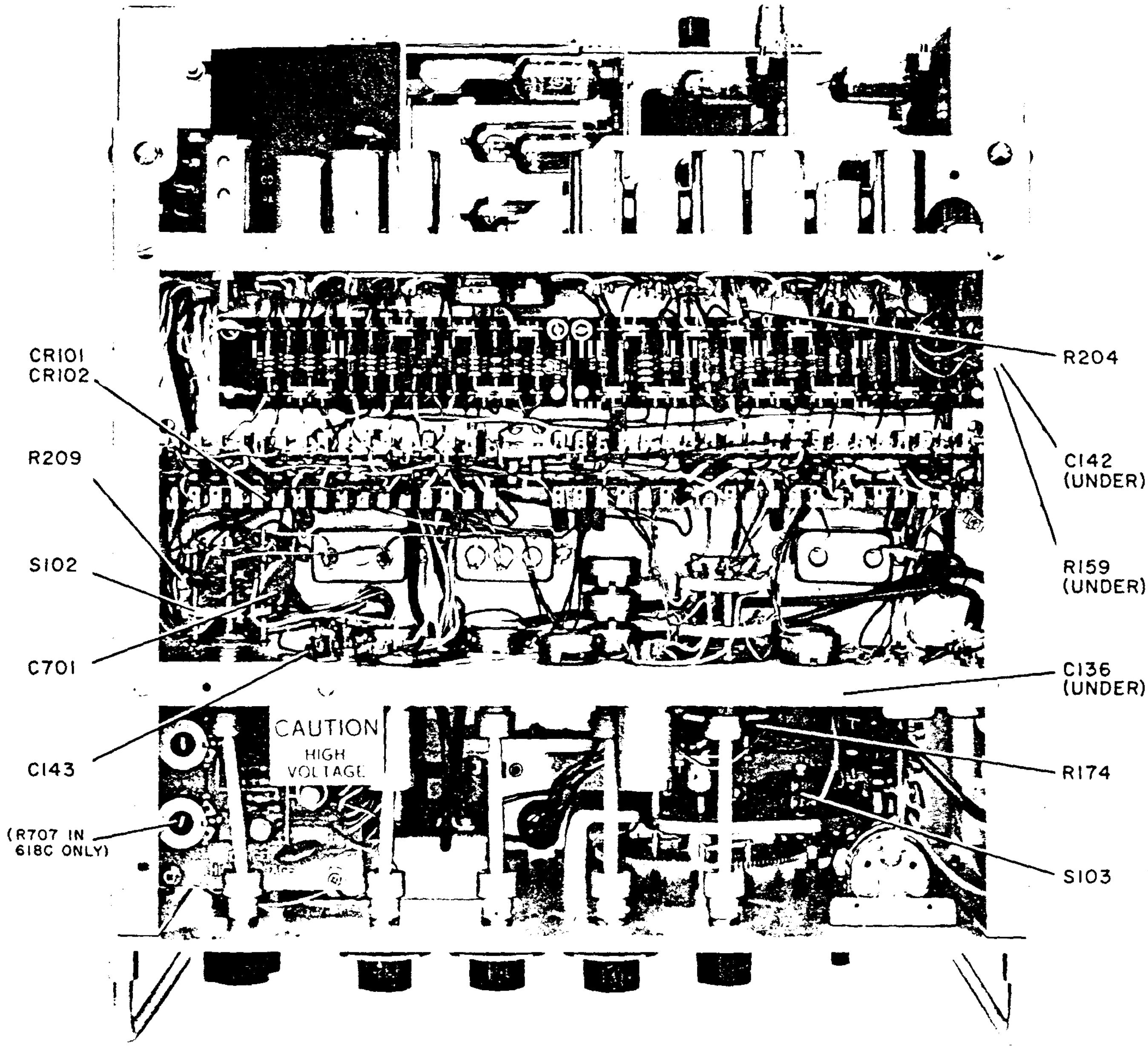


Figure II-1. Interior View Showing Locations of Unlabeled Chassis Components, Top View, (P/O Change H)

CHANGE I

Page 6-8, Table 6-2:
Change S1 to 3101-0100 SWITCH-PB SPDT ALTNG 5A 115 VAC.

HANGE J

e 6-7, Table 6-2:
Change FL301 to 9110-0014 FILTER, LINE.
Change J301 to 1251-0148 CONNECTOR-AC PWR HP-8 MALE FLG-MTG.

Page 6-9, Table 6-2:
Change the power cable, 8120-1378, to 8120-0078 CABLE ASSEMBLY 18 AWG 3-CNDCT BLK-JKT 0.25-OD.

CHANGE K

Page 5-31/5-32, Figure 5-28:
Delete diode CR103.

Page 6-7, Table 6-2:
Delete CR103.

CHANGE L

Page 6-4, Table 6-2:
Change R612 to 2100-0898.

CHANGE M

Page 5-33/5-34, Figure 5-29:
At the junction R159-C143, delete the reference "−300V FROM A800 . . . "; replace it with ⟨1⟩ (−300V).

Page 5-35, Figure 5-30:
Delete C145, R211, and the reference to −300V from A800, etc. On S102E, connect switch position 7 to a corresponding position 7 on S102G.

Page 6-7, Table 6-2:
Delete C145.

Page 6-8, Table 6-2:
Delete R211.

Page 6-9, Table 6-2:
Delete cable 618B-16L.

CHANGE N

Page I-4, Parts List for Figure I-2:
Change items 49, 50, and 51 as follows:

49. 618B-40B Cover, Frequency Dial
50. 61B-40B-1 Cover, Attenuator Dial
51. 00618-020 Panel, Front
    00618-021 Panel, Front (rack mtg).

NOTE

These parts are no longer stocked by Hewlett-Packard but can be special ordered. The corresponding parts, listed in the manual and currently stocked, differ only in color.

CHANGE N (Cont'd)

Page I-32, Parts List for Figure I-15:
Change the stock number for item 1 to 00618-6056.

CHANGE O

Page 5-37/5-38, Figure 5-31:
Replace appropriate portion of schematic with the attached partial schematic:

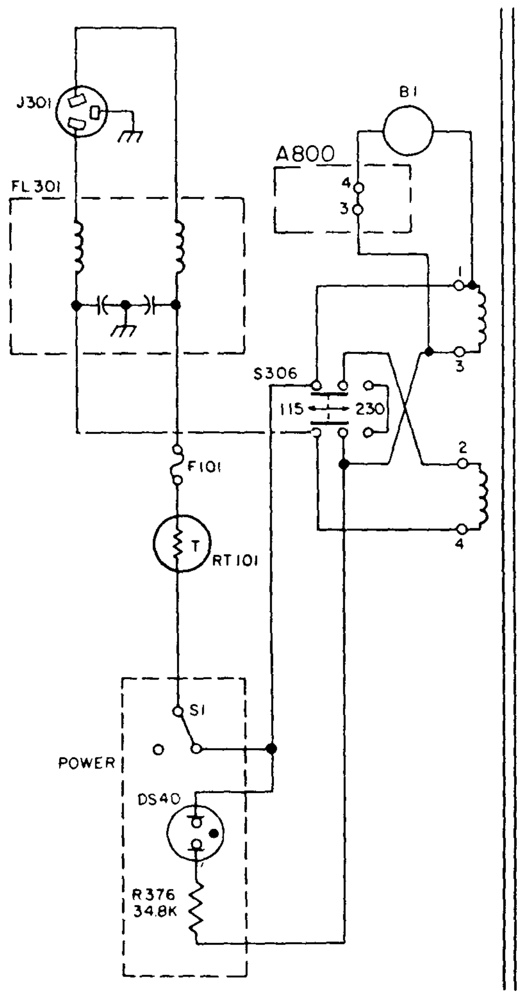


Figure II-2. Partial Schematic for Power Supply Section (P/O Change O)

CHANGE P

Page 5-33/5-34, Figure 5-29:
Change R134* to 3900Ω (typical value only).

Page 6-5, Table 6-2:
Change R134 to 0690-3921 R:FXD COMP 3900 OHM 10% 1W (typical value only).

CHANGE Q

Page 6-6, Table 6-2:
Change C142 to 0160-0088 C:FXD PAPER 0.25 UF 10% 1500 VDCW.

Page 6-6, Table 6-2:
Change C136 to 0160-0088 C:FXD PAPER 0.25 UF 10% 1500 VDCW.
Change C407, C508, and C509 to 0160-0102 C:FXD PAPER 4 UF 10% 1000 VDCW.

CHANGE R

Page 5-5 (Adjustments):
Replace the filament voltage adjustment with the following instruction.

6.3 Vdc FILAMENT VOLTAGE ADJUSTMENT

WARNING

HIGH VOLTAGE. *Measurement points used in this procedure (pins 23 through 28) have 1000 volts potential to chassis. Use extreme care when making the filament voltage measurement. The use of a battery powered voltmeter with a plastic case (such as a Simpson 260) is recommended for this measurement. Do not use an ac powered instrument unless the common can be floated at 1000 Vdc and is isolated from the external chassis.*

Adjust potentiometer R801 for 6.3 Vdc between pins 25 and 26 (not that pins 23, 24, and 25 are common; pins 26, 27 and 28 are common).

Page 5-31/5-32, Figure 5-28:
Change the pin references for "—300V from A800" to pins 9-12 (3 places).
Change the pin references for "—1550V from A800" to pins 13-15 (2 places).

Page 5-35, Figure 5-30:
Change the pin references for "—300V from A800" to pins 9-12 (2 places).

Page 5-37/5-38, Figure 5-31:
Replace component identification photo for A800 with the following photo:

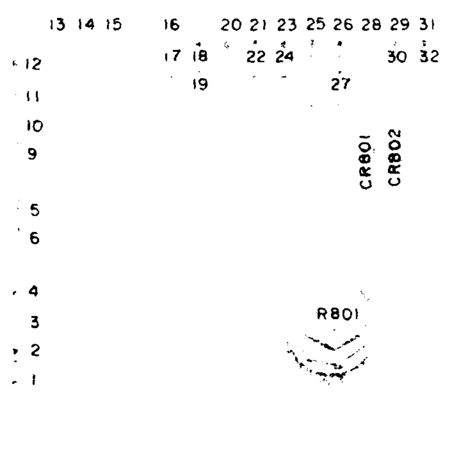


Figure II-3. Component Identification, A800 (P/O Change R)

CHANGE R (Cont'd)

Make the following changes to the schematic:

a. Add the filament for V701 across pins 3 and 4 of A500.
b. Change the pin references for "—300V to A800" to pins 9-12 (at test point 2).
c. Change pin references for "—1550V to A800" to pins 13-15 (at test point 9).
d. Replace appropriate portion of the schematic with the attached partial schematic.

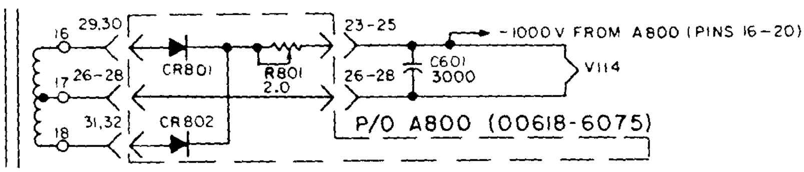


Figure II-4. Partial Schematic for Power Supply Section (P/O Change R)

Pages 6-4 and 6-5, Table 6-2:

Delete the entire A800 assembly parts list; add the following parts in its place.

A800 00618-6075 BOARD ASSEMBLY, INTERCONNECTION
CR801, CR802 1901-0026 DIODE SILICON, 0.75A 200 PIV
R801 2100-0308 R:VAR 2 OHM 10% LIN 5W

Page 6-7, Table 6-2:

Delete Q1.

Page 6-9, Table 6-2:

Delete bracket 00618-00075, and insulator 0340-0875.

CHANGE S

Page 5-37/5-38, Figure 5-31:

Replace component identification photo for A800 with the following photo.
On the schematic, delete diode CR804; connect CR803 to VR801.
On the schematic, delete diode CR805; connect together VR801, R802, and the base of Q802.

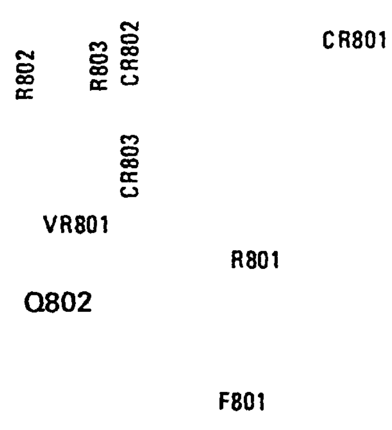


Figure II-5. Component Identification, A800 (P/O Change S)

CHANGE S (Cont'd)

ıge 6-4, Table 6-2:
Delete CR804 and CR805.

Page 6-7, Table 6-2:
Delete the following parts under F101:
2110-0470
1400-0090
2110-0465
2110-0467
Add the following part number in their place:
1400-0084

NOTE

If any part of the old fuseholder (1400-0084) needs replacing, all four parts of the new fuseholder must be ordered. The old fuseholder can be identified by a straight solder lug to which the white-black-gray wire attaches. On the new fuseholder the solder lug is at a right angle to the body.

Page I-10, Parts List for Figure I-5:
Add the following items:

17.	00618-238	Adapter
57.	2190-0016	Washer, Int lock, 1/2 in. od
58.	2950-0001	Nut, 1/2 in. wide 3/8-32 thd, br.

'age I-12, Figure I-5:
Replace appropriate portion of figure with the attached partial view.

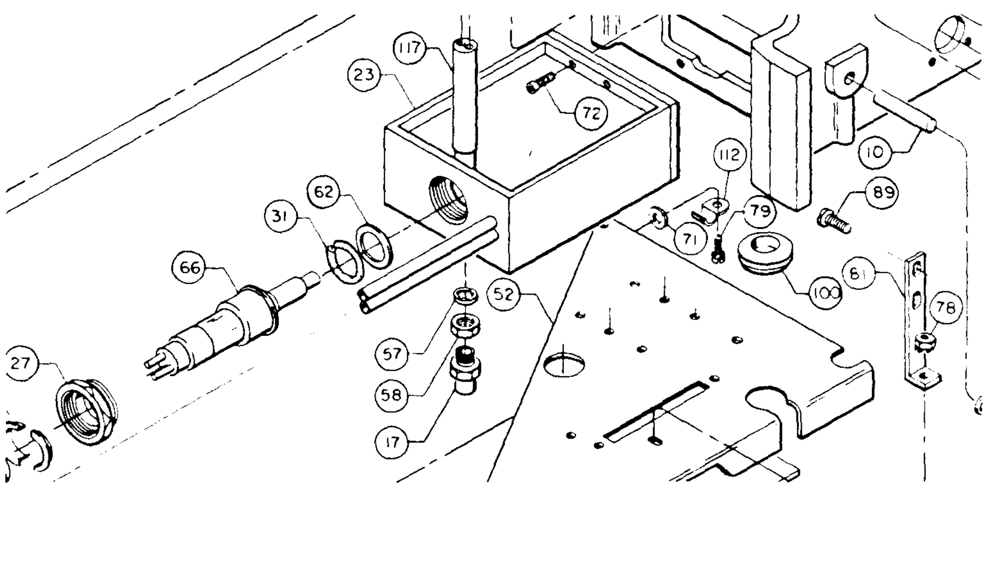


Figure II-6. HP Model 618C S.H.F. Signal Generator, Klystron Assembly and Drive Mechanism (partial view, P/O Change S)

CHANGE T

Page 5-37/5-38, Figure 5-31:
Replace appropriate portion of schematic with the attached partial schematic.

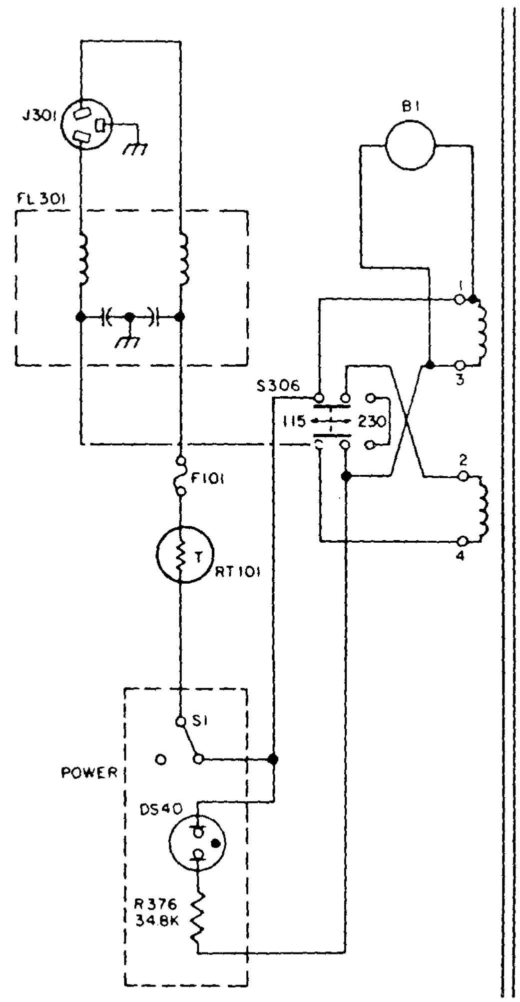


Figure II-7. Partial Schematic for Power Supply Section (P/O Change T)

Page 6-8, Table 6-2:
Change S1 to 3101-1248 SWITCH:PUSHBUTTON SPST ILLUMINATED.

Page I-6, Parts List for Figure I-3:
Change stock number for item 12 to 3101-1248.

Pages I-10 and I-11, Parts List for Figure I-5:
Change item 18 to 618B-36AT Ring, Pot Mounting.
Change part number for item 52 to 00618-0041.
Add the following items:

86.	08412-20022	Spacer HVRS Rec.
87.	0380-0046	Spacer, rnd, 0.375 in. lg.
104.	0360-0023	Strip, 7 terminal, 5 ins, 2 gnd.
105.	2190-0010	Washer, Ext lock for no.8 screw
108.	0380-0013	Spacer, 1/4 in. od, 1 in. lg.

Delete item 119.
Change item 107 to 2380-0007 Screw, Fillister head, 6-32 thd, 1-1/4 in. lg.
Change item 116 to 2360-0207 Screw: Machine 6-32 x 0.87.

CHANGE T (Cont'd)

age I-12, Figure I-5:
Replace the entire figure with Figure II-8.

Page I-13, Figure I-6:
Replace the entire figure with Figure II-9.

Pages I-14 and I-15, Parts List for Figure I-6:
Change item 18 to 618B-36AT Ring, pot mounting.
Change the part number for item 52 to 00618-0041.
Add the following items:

86.	08412-20022	Spacer:HVRS Rec
87.	0380-0046,	Spacer: Rnd. 0.375 in. lg.
88.	0360-0023	Strip, 7 terminal, 5 ins, 2 gnd
91.	2190-0010	Washer, Ext lock for no.8 screw
106.	0380-0013	Spacer, 1/4 in. od, 1 in. lg.

Change item 105 to 2380-0007 Screw, Fillister head, 6-32 thd, 1-1/4 in. lg.
Change item 118 to 2360-0207 Screw: Machine 6-32 x 0.87.
Delete items 120 and 122.

CHANGE U

Page I-18, Parts List for Figure I-8:
Change item 12 to 620A-36H.

CHANGE V

Page 5-37/5-38, Figure 5-31:
Change potentiometers R412 and R512 to 25K.
Change VR801 to 7.15V.
Change Q1 to 1850-0098.

Page 6-3 and 6-4, Table 6-2:
Change R412 and R512 to 2100-1472 R:VAR COMP 25K OHM 30% LIN 1/8W.

Page 6-5, Table 6-2:
Change VR801 to 1902-0074 DIODE ZNR 7.15V 5% DP-7 PD=0.4W.

Page 6-7, Table 6-2:
Change Q1 to 1850-0098 TRANSISTOR PNP GE CHIP TO-3 PD=90W.

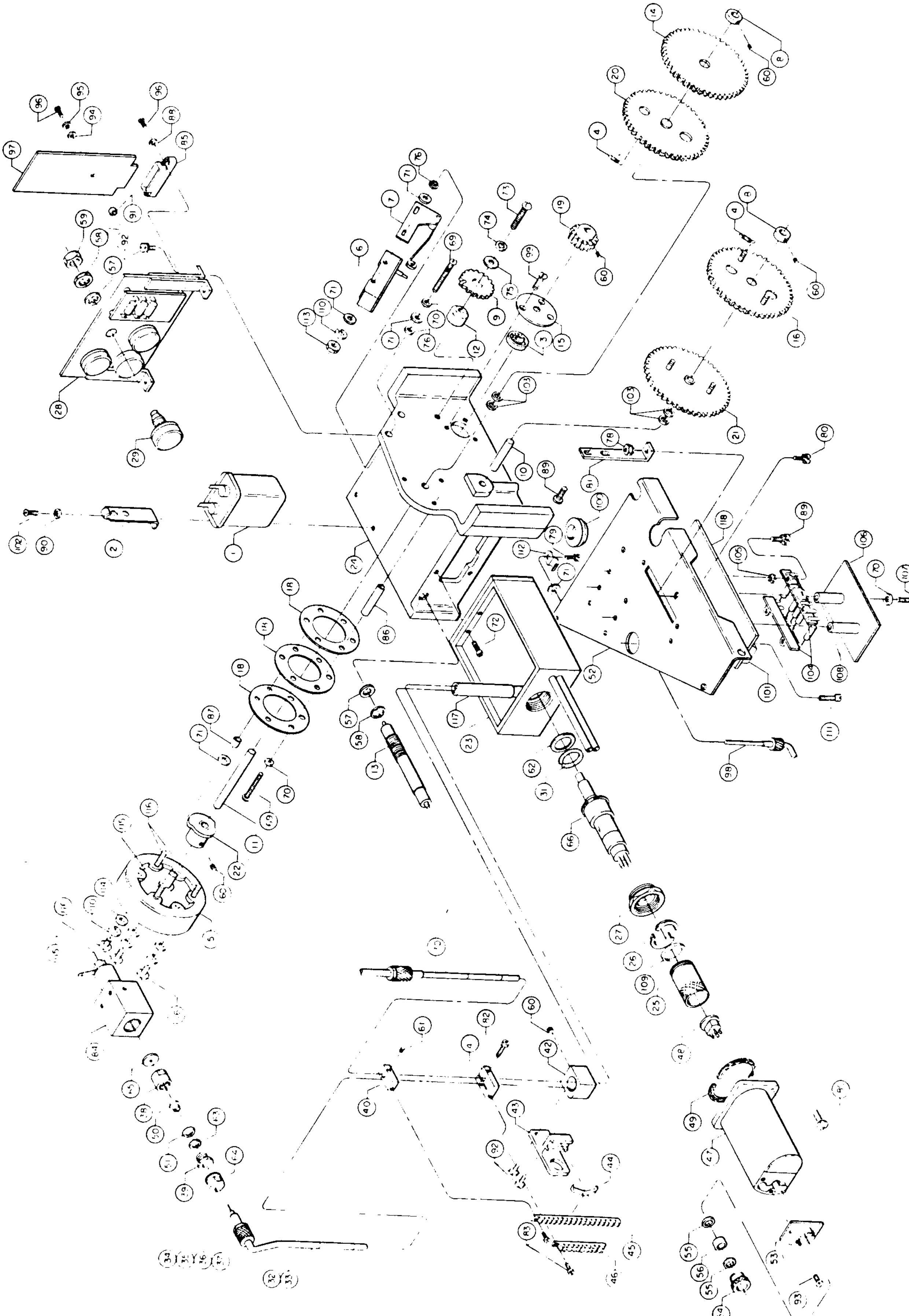


Figure II-8. HP Model 618C S.H.F. Signal Generator, Klystron Assembly and Drive Mechanism (P/O Change T)

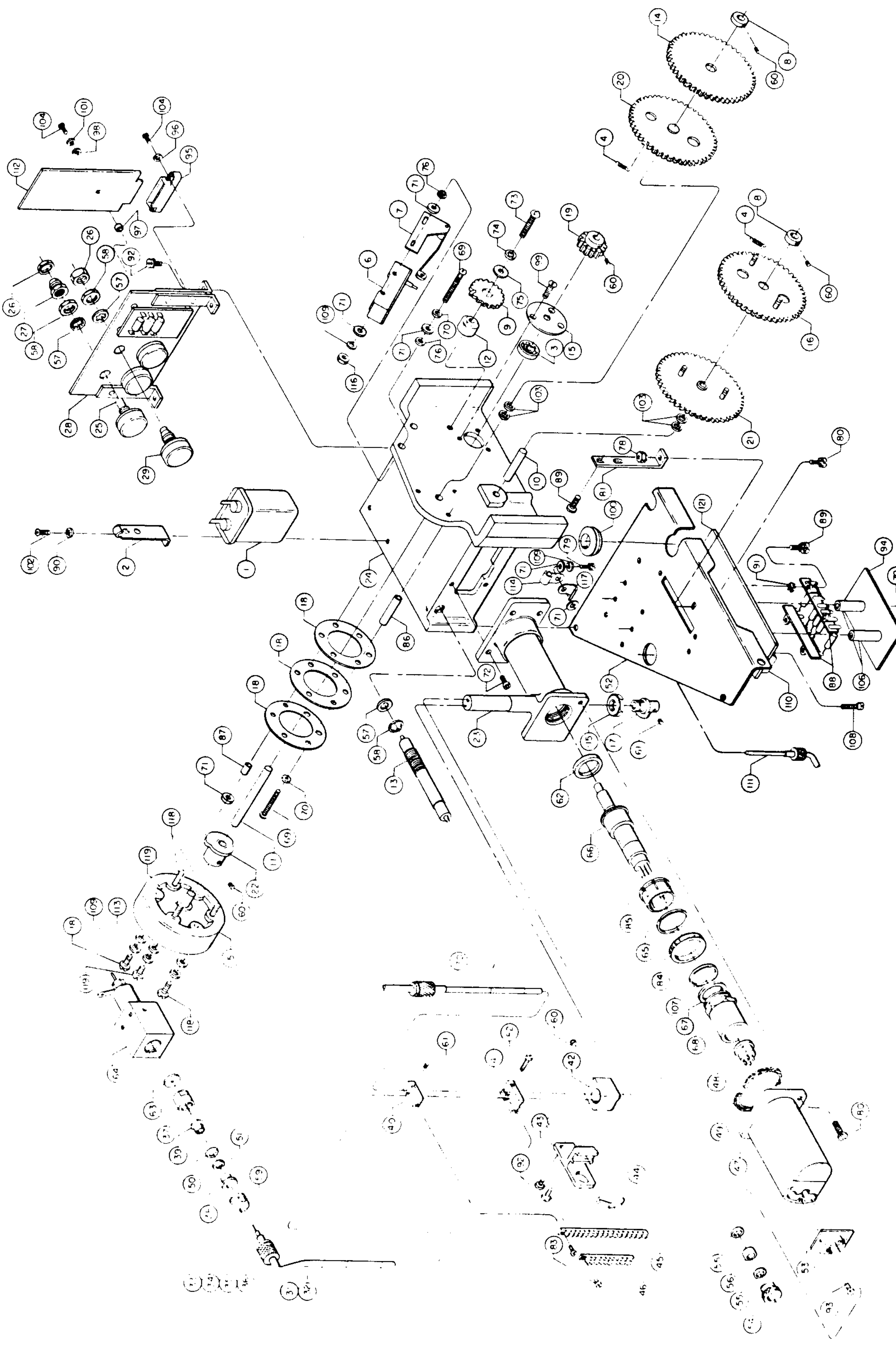


Figure II-9. HP Model 620B S.H.F. Signal Generator, Klystron Assembly and Drive Mechanism (P/O Change T)

MANUAL IDENTIFICATION	
Model Number:	618C/620B
Date Printed:	April 1980
Part Number:	00618-90029

SHF SIGNAL GENERATOR

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after the printing of the manual.

To use this supplement:

Make all ERRATA corrections

Make all appropriate serial number related changes indicated in the tables below.

618C

Serial Prefix or Number	Make Manual Changes
1740A	1
1824A	1, 2
1911A	1—3
2031A	1—4

620B

Serial Prefix or Number	Make Manual Changes
1745A	1
1826A	1, 2
1914A	1—3
2040A	1—4

► NEW ITEM

ERRATA

Page 3-7, Figure 3-5:

Add the following note:

SYNC. IN should not be used when the MOD. SELECTOR is in the + EXT. position. Spurious output may result.

Page 5-2, First table:

Change 5.653—5.7057 GHz to 5.643—5.757 GHz

Page 5-3, Figure 5-3:

Add a 20 dB attenuator at the input of the frequency counter.

Page 5-19, Paragraph h (column one):

► Change information inside the first set of parentheses to (approximately 8.9 GHz for the 620B and 4.2 GHz for the 618C).

Page 5-23:

Add the following paragraphs:

5-104. FACTORY SELECTED COMPONENTS

5-105. The following paragraphs explain how to choose the values of selected components. These components are designated by an asterisk (*) on the schematic and parts list.

5-106. SELECTING R157

5-107. Selected for minimum detected pulse width measured at the RF OUTPUTS when pulse modulating the Generator. If a minimum pulse width of 0.5 μs cannot be obtained, change R157 to a lower value. The value should be between 1000Ω and 2200Ω.

NOTE

Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies quote the manual identification information from your supplement, or the model number and print date from the title page of the manual.

6 December 1982
10 Pages

HEWLETT PACKARD

Printed in U.S.A.

ERRATA (Cont'd)

ge 5-23 (cont'd):

5-108. SELECTING CR701

5-109. The zener voltage of CR701 is selected so that the voltage on the plate of VR701 is more negative than −1020 Vdc with the MOD SELECTOR set to OFF. The range of CR701 is 100 to 120 volts (120 volts nominal).

NOTE

CR701 should be selected each time VR701 is replaced.

Page 5-31, Figure 5-28:

Add CR103 to the R169 connection for the 620B as follows:

CR103 Anode — junction of TB1(1) and R169.

CR103 Cathode — connection to the TB1 side of R177.

Change R603 to 147Ω.

Delete the R523 (ΔF) wiper connection to ground. Connect the wiper to the junction of R523 and R527.

Add R527 to Reference Designators table.

When the changing of R523 is necessary the recommended replacement is listed in **Change 4**.

(620B Only) Page 5-31/5-32, Figure 5-28:

Change the color code of the wire connected to the wiper of R168 from green (5) to brown (1).

Page 5-33/5-34, Figure 5-29 (Schematic and Component Identification):

Change voltage on V101 pin 6 to −240V. Change (on Component Identification, A1000) C142 to C143.

Change (on Component Identification, A900) C142 to C143 and C143 to C144.

Page 5-35, Figure 5-30 (Schematic and Component Identification):

Change R157 to R157*.

Add the following note at the bottom of the page:

*Selected value. See paragraph 5-106 for selection procedure.

Change (on Component Identification, A900) C142 to C143 and C143 to C144.

Page 5-37, Figure 5-31 (Component Identification):

Show (on Component Identification A800) the wire colors attached to the pins as listed in the following table:

Change (on Component Identification A900) C142 to C143 and C143 to C144).

Pin Number	Wire Color	Pin Number	Wire Color
1	—	16	violet
2	—	17	violet
3	yellow	18	violet
4	yellow	19	violet
5	pink	20	—
6	pink	21	white/green
7	white/red	22	white
8	red	23	white/violet
9	—	24	green
10	red	25	brown
11	red	26	white/yellow
12	orange	27	green
13	orange	28	white/black/grey
14	—	29	white
15	—	30	grey

CHANGE 1

Page 4-7, paragraph 4-36:

Add the following information.

CR704 is selected for optimum tuning range of R706. CR706 is selected for optimum tuning range of R707. R709 adjusts the leading edge of the modulation pulse.

Page 4-7:

Replace Figure 4-11 with the following figure.

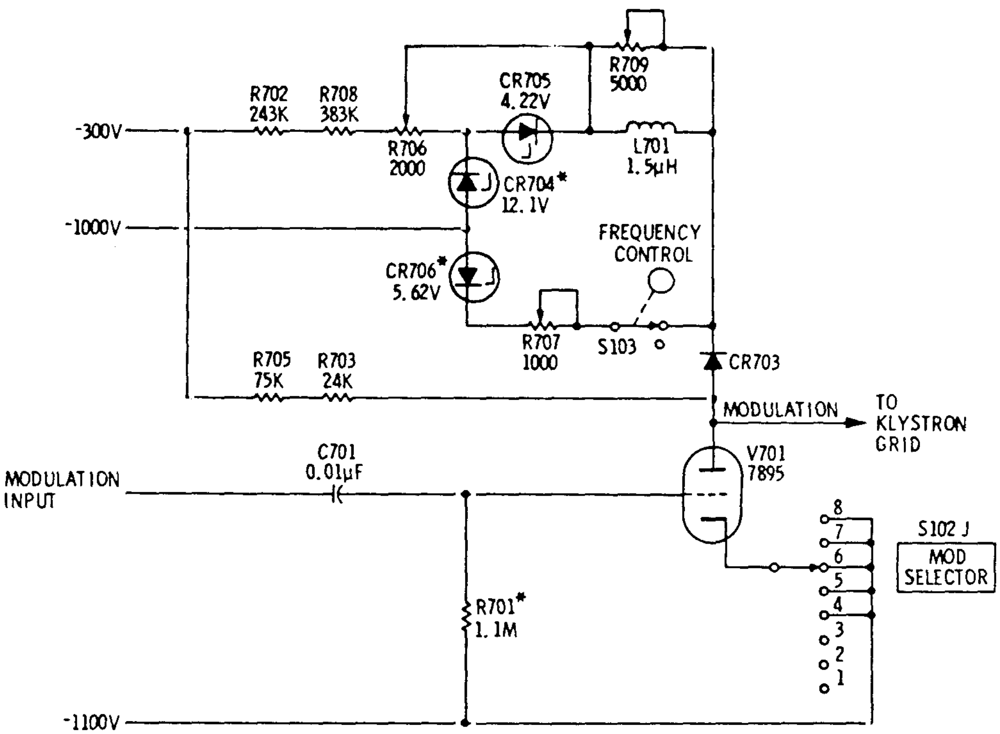


Figure 4-11. Schematic of Klystron Modulator (618C, Change 1)

Pages 4-7 and 4-8, paragraph 4-37:

Add the following information.

Zener diode CR704 is selected for optimum tuning range of R706. R709 adjusts the leading edge of the modulation pulse.

Replace Figure 4-12 with the following figure.

CHANGE 1 (Cont'd)

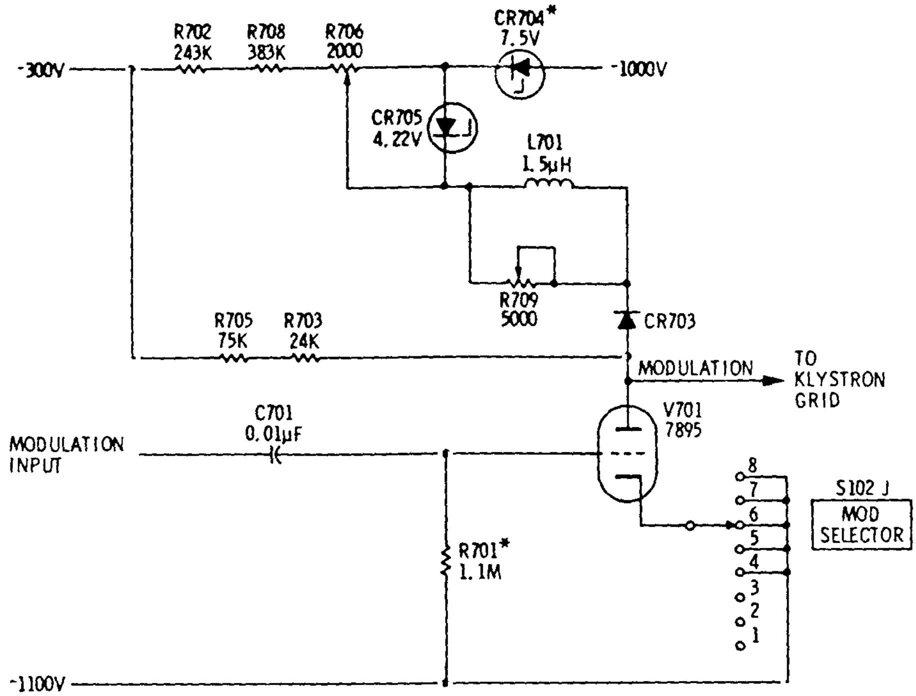


Figure 4-12. Schematic of Klystron Modulator (620B, Change 1)

Pages 5-6 and 5-7, paragraph 5-30:

In step c, change "approximately 15 mA" to "nominally 15 mA"

Add the following instructions after step c.

Select the value of CR706 as high as possible to obtain proper cathode current. A 4.22V zener diode is typical. Adjust R707 almost fully counterclockwise. This will generally result in the best pulse shape (refer to Figure 5-8a). Increasing zener voltage will raise the range of current adjustment. Refer to Table 5-2a for the HP part number for various zener voltages within the allowable range.

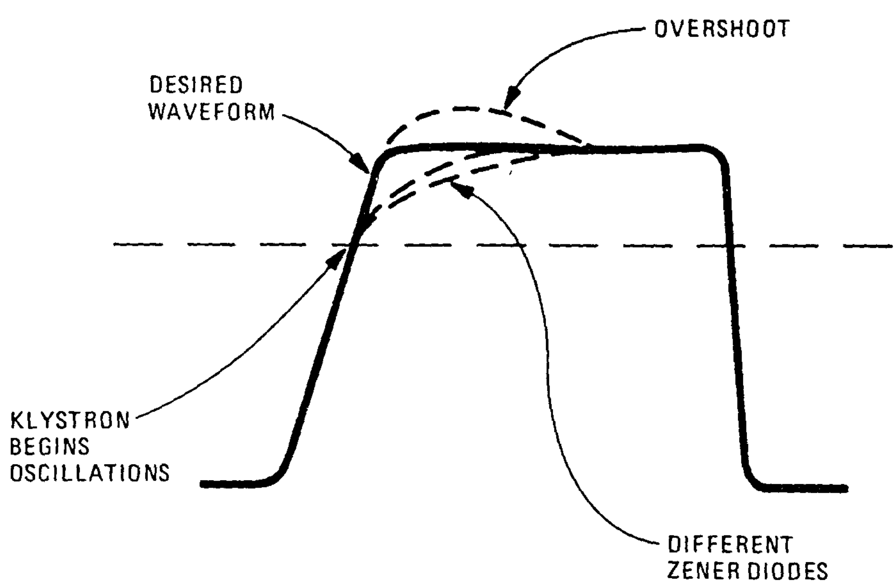


Figure 5-8a. Klystron Modulation Pulse Waveform (Change 1)

CHANGE 1 (Cont'd)

Pages 5-6 and 5-7, paragraph 5-30 (cont'd):

To select the value of CR704, tune the 618C above the frequency where the microswitch is actuated. Measure klystron beam current with R706 and R709 set fully counterclockwise. The minimum current should be about 25mA. If the minimum current is not correct, change the value of CR704 to obtain proper minimum current. A 7.5V zener is typical. Decreasing zener voltage will decrease klystron beam current. Use Table 5-2a to find the HP part number for various zener voltages within the allowable range. Adjust the beam current to get minimum pulse jitter consistent with best pulse shape. Beam current should be kept below 28mA. If necessary, rotate R709 clockwise to reduce jitter. Keep R709 as far counterclockwise as possible to maintain the best possible pulse shape.

Table 5-2a. CR704 and CR706 Selection Guide

Zener Voltage	HP Part Number
3.16V	1902-3036
3.48V	1902-3048
3.83V	1902-3059
4.22V	1902-3070
4.64V	1902-3082
5.11V	1902-0041
5.62V	1902-3104
6.19V	1902-0049
6.81V	1902-0048
7.50V	1902-0064
8.25V	1902-3139
9.09V	1902-3149
10.0V	1902-0025
11.0V	1902-3171
12.1V	1902-3182
13.3V	1902-3193
14.7V	1902-3203
16.2V	1902-0184

Pages 5-6 and 5-7, paragraph 5-30 (cont'd):

Change step f to read as follows:

Adjust R170 and R709 for best compromise between pulse shape and jitter. The best pulse shape generally occurs with R709 adjusted fully ccw.

Add the following instruction to step m.

If necessary, readjust R709 for optimum pulse shape and minimum acceptable jitter.

Pages 5-7 to 5-9, paragraph 5-32:

Add the following instructions to step d.

To select the value of CR704 the 620B can be tuned anywhere in the frequency band. Measure klystron beam current with R706 and R709 set fully counterclockwise. The minimum current should be about 25mA. If the minimum current is not correct, change the value of CR704 to obtain proper minimum current. A 7.5V zener is typical. Decreasing zener voltage will decrease klystron beam current. Use Table 5-2a to find the HP part number for various zener voltages within the allowable range. Adjust the beam current to get minimum pulse jitter consistent with best pulse shape. Beam current should be kept below 28mA. If necessary, rotate R709 clockwise to reduce jitter. Keep R709 as far counterclockwise as possible to maintain the best possible pulse shape.

CHANGE 1 (Cont'd)

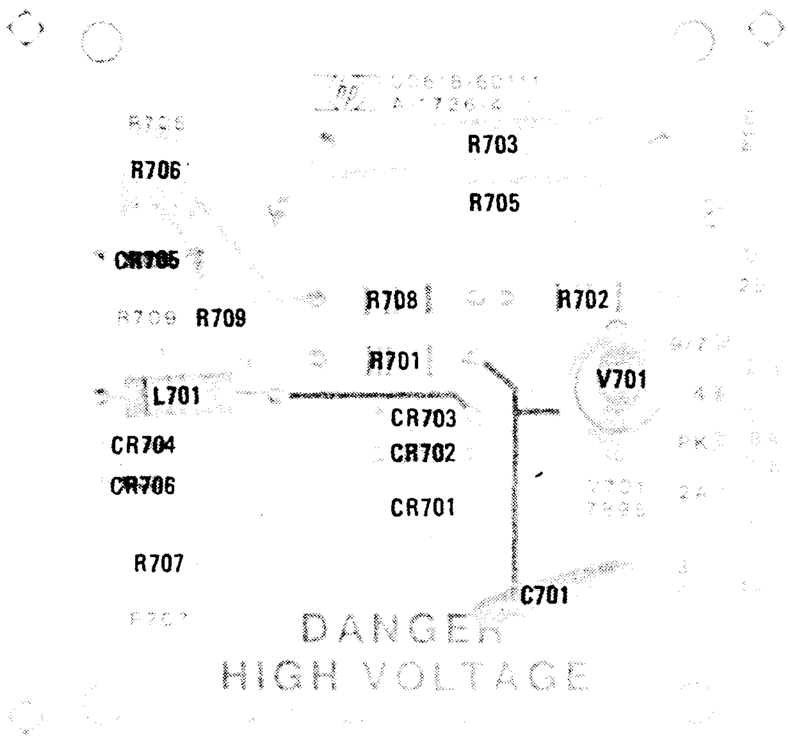
ge 5-7 to 5-9, paragraph 5-32 (continued):

Add the following instructions to step q.

Adjust R709 to obtain optimum pulse shape with minimum acceptable jitter. In some cases to minimize jitter, it might be necessary to allow slight overshoot of the leading edge (see Figure 5-8a). The best pulse shape generally occurs with R709 adjusted fully ccw.

Page 5-31, Figure 5-28:

Replace component identification photograph for A700 with the following photograph.



Component Identification, A700

Replace appropriate parts of schematic with the following partial schematic.

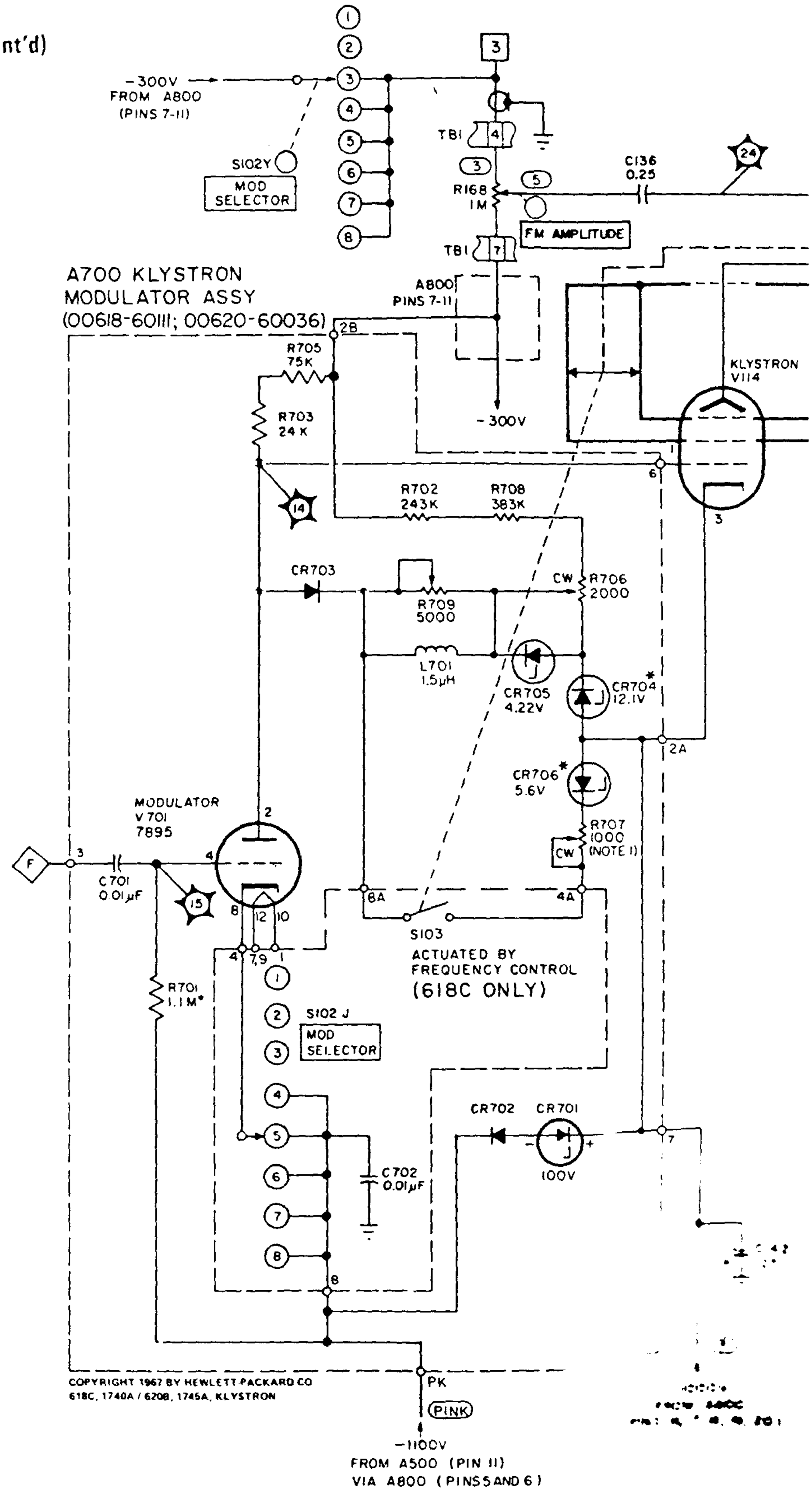
Also on schematic, change note 1 and the asterisk note (*) to read as follows.

1. R707, CR706, and S103 are included in 618C's only; omitted in 620B's.

* Factory selected part; typical value shown (typical value for CR704 on 620B's is 7.5V).

Continued . . . .

CHANGE 1 (Cont'd)



P/O Figure 5-28. Klystron Sectior

CHANGE 1 (Cont'd)

ȝC Only) Page 5-31/5-32, Figure 5-28:
Change the color code of the wire connected to the wiper of R168 from green (5) to brown (1) .

Page 6-4, Table 6-2:
Add CR704 1902-3182 CD0 DIODE ZENER 12.1V 5% DO-35 PD = 0.4W.
Add CR705 1902-3070 CD5 DIODE ZENER 4.22V 5% DO-35 PD = 0.4W.
Add CR706 1902-3104 CD6 DIODE ZENER 5.62V 5% DO-35 PD = 0.4W.
Add L701 9100-1657 CD8 INDUCTOR RF-CH-MLD 1.5 MH 5% .23D x .57 LG.
Change R706 to 2100-0567 CD0 RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN.
Change R707 to 2100-3211 CD7 RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN.
Add R709 2100-3252 CD6 RESISTOR-TRMR 5K 10% C TOP-ADJ 1-TRN.

CHANGE 2

Page 6-7, Table 6-2:
Replace the fuseholder listing (below F101) with the following:
2110-0564 FUSHEHOLDER BODY 12A MAX; 250V MAX 28480 2110-0564
2110-0565 FUSEHOLDER CAP BAYONET; 12A 250V MAX 28480 2110-0565
2110-0569 NUT-HEX, PLASTIC 28480 2110-0569
1400-0090 WASHER: RUBBER 5/8" OD 00000 OBD

ˆHANGE 3

ᴊge 1-2, Table 1-1:
Replace the **Sync Out Signals**, and **External Pulse Modulation** specifications with the following:

Sync Out Signals: Simultaneous with RF pulse, positive. In advance of RF pulse, positive, variable 3 to 300 microseconds. (Better than 1 microsecond rise time and 20 to 100 volts amplitude into 1,000-ohm load.)

External Pulse Modulation: Pulse requirements: amplitude from 15 to 70 volts peak positive or negative, width 0.5 to 2,500 microseconds.

Page 5-3, Paragraph 5-19:
Replace steps c and h with the following:

c. Adjust Pulse Generator for a +15V peak, 1000-Hz output with a pulse width of 0.5 μs.

h. Adjust Pulse Generator for +15V peak output. Display should be the same as in step g.

CHANGE 4

Page 5-31/5-32, Figure 5-28:
Change R523 to 500K.

Page 5-33/34, Figure 5-29:
Add C150 56 pF connected from V101-pin 7 to pin 8.

Page 6-7, Table 6-2:
Add C150, 0140-0191, Check Digit 8, CAPACITOR-FXD 56 PF ±5% 300VDC.

e 6-8, Table 6-2:
Change R523 to 2100-2736 CD9 RESISTOR-VAR CONTROL C 500K 20% LIN.